



SCIENCE, TECHNOLOGY & ENGINEERING, AND
ENVIRONMENTAL LITERACY & SUSTAINABILITY STANDARDS
(STEELS)

K-12 FOUNDATION BOXES

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Introduction

Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards guide the study of the natural and human-made world through inquiry, problem-solving, critical thinking, and authentic exploration. The integration of these disciplines in the standards highlights the interconnectedness of scientific, technological, and engineering focused study; the integral relationship between humans and the environment; and the importance of integrating the teaching and learning of science, technology, and engineering.

Standard Design and Architecture

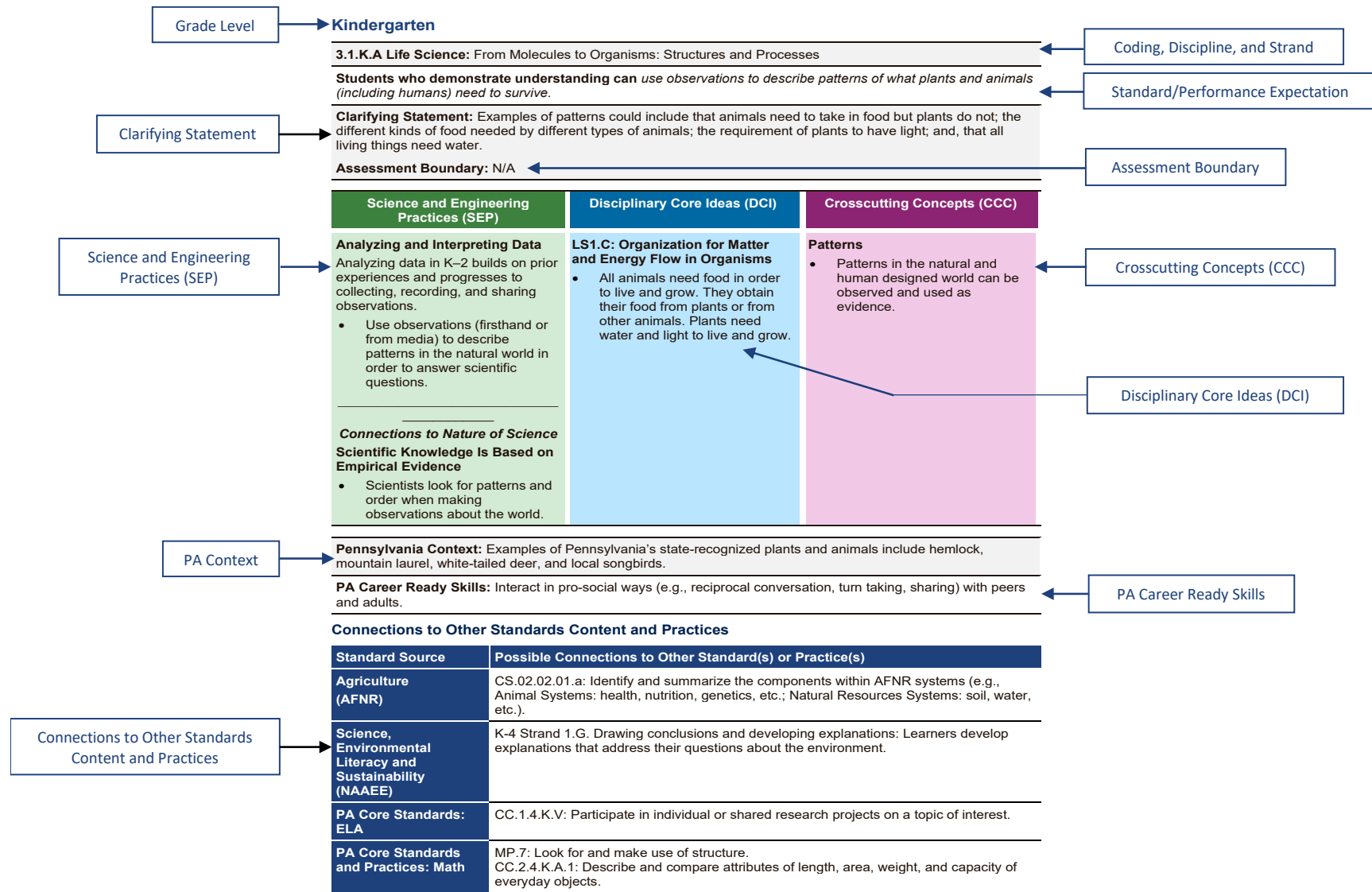
Science – Life Science focuses on patterns, processes, and relationships of living organisms. Physical Science focuses on what everything is made of and interactions. Earth & Space Science focuses on processes that operate on Earth and its place in the solar system and galaxy. Life Science, Physical Science, and Earth & Space Science are written as *grade-specific (Grades K-5) or grade-banded (6-8, 9-12)* performance expectations and built around three dimensions—[science and engineering practices](#), disciplinary core ideas, and [crosscutting concepts](#)—integrated into a set of specific standards. These dimensions are elaborated upon in Foundation Boxes (hyperlinked for each standard) providing support for design of curriculum and instruction.

Technology & Engineering - Focuses on the interactions among technology, engineering, society, the environment, and other disciplines, with a goal of developing individuals that can create, utilize, and assess current and emerging technologies. The standards are written as *grade-banded* performance expectations built around [technology and engineering strands, practices](#), and [contexts](#) and integrated into a set of specific standards. These components are elaborated upon in Foundation Boxes (hyperlinked for each standard) providing support for design of curriculum and instruction.

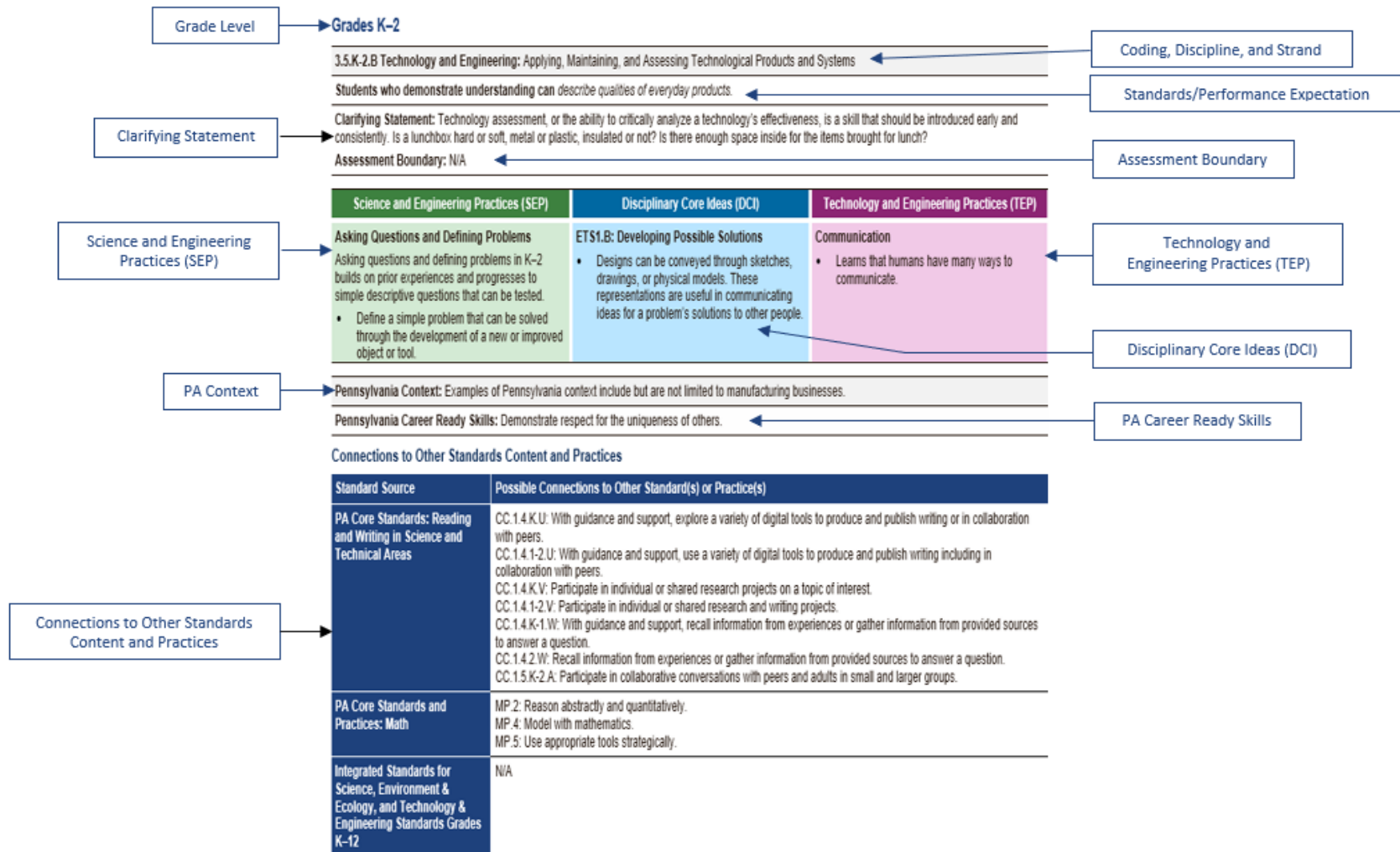
Environmental Literacy & Sustainability - Focuses on practices, ecological processes, and systems that comprise the environment, including human social systems and influences. The standards are written as *grade-banded* performance expectations and built around three dimensions—[science and engineering practices](#), disciplinary core ideas, and [crosscutting concepts](#)—integrated into a set of specific standards. Sustainability is the balanced use of natural and renewable resources. Sustainable practices seek to ensure the integrity of ecological function and species diversity, with consideration for environmental justice, equity, and economic stability for current and future generations. These dimensions are elaborated upon in Foundation Boxes (hyperlinked for each standard) providing support for design of curriculum and instruction.

Foundation Box Architecture

Science and Environment & Ecology Example



Technology & Engineering Example

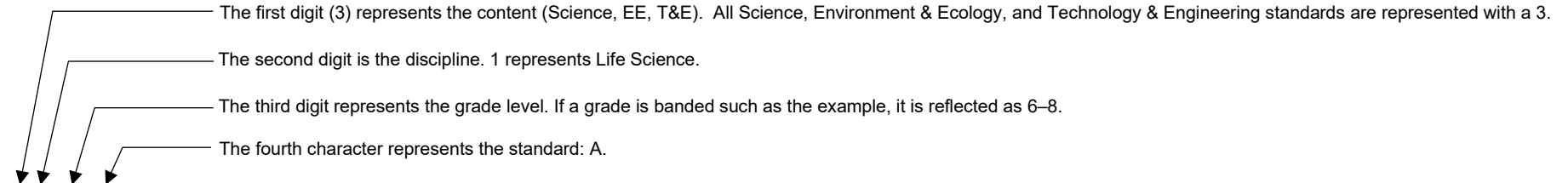




Coding, Discipline, and Strand

Coding

Each standard has a four-digit code. In the example below, for standard 3.1.6-8.A:



3.1.6-8.A - Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.

Discipline – Science, Environmental Literacy & Sustainability, and Technology & Engineering

Strand – organizational structure within each discipline.



Glossary

Assessment Boundary - specify limits to large-scale assessment. They are not meant to put limits on what can be taught or how it is taught, but to provide guidance to assessment developers.

Clarifying Statement - supply examples or additional clarification and emphasis to the language of the performance expectations.

Connections to Other Standards Content and Practices - connection boxes are provided to support interdisciplinary connections and integration. Educators can use these connections to reinforce student learning by emphasizing experiences in multiple content areas and contexts to support authentic learning.

Crosscutting Concepts (CCC) - these are concepts that hold true across the natural and engineered world. Students can use them to make connections across seemingly disparate disciplines or situations, connect new learning to prior experiences, and more deeply engage with material across the other dimensions.

Disciplinary Core Ideas (DCI) - the fundamental ideas that are necessary for understanding a given discipline. The core ideas all have broad importance within or across science or engineering disciplines, provide a key tool for understanding or investigating complex ideas and solving problems, relate to societal or personal concerns, and can be taught over multiple grade levels at progressive levels of depth and complexity.

Grade Level – grades 1, 2, 3, 4, 5, or grade bands K-2, 3-5, 6-8, 9-12.

PA Career Ready Skills - social emotional learning progressions that support the development of student competence.

PA Context - links to possible PA connections that allow for integrated instruction that leverages local and regional contexts.

Standards/Performance Expectation - assessable statements of what students should know and be able to do.

Science and Engineering Practice (SEP) - the practices are what students do to make sense of phenomena. They are both a set of skills and a set of knowledge to be internalized. The SEPs reflect the major practices that scientists and engineers use to investigate the world and design and build systems.

Technology and Engineering Practices (TEP) - student-centered set of practices that reflect the knowledge, skills, and dispositions students need in order to successfully apply the core disciplinary standards in the different context areas.

Kindergarten

3.1.K.A Life Science: From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can use observations to describe patterns of what plants and animals (including humans) need to survive.

Clarifying Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. - Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. Connections to Nature of Science Scientific Knowledge Is Based on Empirical Evidence - Scientists look for patterns and order when making observations about the world.	Organization for Matter and Energy Flow in Organisms All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.	Patterns Patterns in the natural and human designed world can be observed and used as evidence.

Pennsylvania Context: Examples of Pennsylvania’s state-recognized plants and animals include hemlock, mountain laurel, white-tailed deer, and local songbirds.

PA Career Ready Skills: Interact in pro-social ways (e.g., reciprocal conversation, turn taking, sharing) with peers and adults.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.G. Drawing conclusions and developing explanations: Learners develop explanations that address their questions about the environment.
PA Core Standards: ELA	CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.7: Look for and make use of structure. CC.2.4.K.A.1: Describe and compare attributes of length, area, weight, and capacity of everyday objects.
PA Standards: Social Studies	6.4.K.D: Identify individual wants and needs.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3A: Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.

Kindergarten

3.2.K.A Physical Science: Motion and Stability: Forces and Interactions

Students who demonstrate understanding can analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

Clarifying Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.

Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Analyze data from tests of an object or tool to determine if it works as intended.	Forces and Motion - Pushes and pulls can have different strengths and directions. - Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. Defining Engineering Problems - A situation that people want to change or create can be approached as a problem to be solved through engineering.	Cause and Effect Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Pennsylvania Context: N/A

PA Career Ready Skills: Engage in reciprocal communication with peers and adults.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.E. Organizing and analyzing information: Learners describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.
PA Core Standards: ELA	CC.1.5.K.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.K.A.3: Apply the concept of magnitude to compare numbers and quantities.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	8.1.K.B: With guidance and support, differentiate facts from opinions as related to an event. 8.1.K.C: Explain how to locate information in a source.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-7E: Illustrate that there are different solutions to a design and that none are perfect.

Kindergarten

3.2.K.B Physical Science: Motion and Stability: Forces and Interactions

Students who demonstrate understanding can *plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.*

Clarifying Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.

Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers.	Forces and Motion - Pushes and pulls can have different strengths and directions. - Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. Types of Interactions - When objects touch or collide, they push on one another and can change motion. Relationship Between Energy and Forces - A bigger push or pull makes things speed up or slow down more quickly.	Cause and Effect Simple tests can be designed to gather evidence to support or refute student ideas about causes.
Connections to Nature of Science Scientific Investigations Use a Variety of Methods Scientists use different ways to study the world.		

Pennsylvania Context: N/A

PA Career Ready Skills: Interact in pro-social ways (e.g., reciprocal conversation, turn taking, sharing) with peers and adults.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.B. Designing investigations: Learners design simple environmental investigations.
PA Core Standards: ELA	CC.1.5.K.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.K.A.1: Describe and compare attributes of length, area, weight, and capacity of everyday objects.
PA Standards: Social Studies	5.4.K.B: Identify how students can work together.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-2D: Develop a plan in order to complete a task.

Kindergarten

3.2.K.C Physical Science: Energy

Students who demonstrate understanding can *make observations to determine the effect of sunlight on Earth's surface.*

Clarifying Statement: Examples of Earth's surface could include sand, soil, rocks, and water

Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. - Make observations (firsthand or from media) to collect data that can be used to make comparisons. Connections to Nature of Science Scientific Investigations Use a Variety of Methods - Scientists use different ways to study the world.	Conservation of Energy and Energy Transfer Sunlight warms Earth's surface.	Cause and Effect Events have causes that generate observable patterns.

Pennsylvania Context: N/A

PA Career Ready Skills: Interact in pro-social ways (e.g., reciprocal conversation, turn taking, sharing) with peers and adults.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.C. Collecting information: Learners locate and collect information about the environment and environmental topics.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.5.K.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. CC.2.1.K.A.3: Apply the concept of magnitude to compare numbers and quantities.
PA Standards: Social Studies	7.3.K.A: Describe how weather affects daily life.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-8A: Analyze how things work.

Kindergarten

3.2.K.D Physical Science: Energy

Students who demonstrate understanding can *use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.*

Clarifying Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.	Conservation of Energy and Energy Transfer Sunlight warms Earth's surface.	Cause and Effect Events have causes that generate observable patterns.

Pennsylvania Context: Examples of Pennsylvania context include materials found naturally in Pennsylvania, such as wood from the state's forests.

PA Career Ready Skills: Interact in pro-social ways (e.g., reciprocal conversation, turn taking, sharing) with peers and adults.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR work-places or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 3.1.C. Identifying and critiquing alternative solutions and courses of action: Learners develop plans, including possible design solutions, for addressing selected local environmental issues.
PA Core Standards: ELA	CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.5.K.A: Participate in collaborative conversations with peers and adults in small and larger groups.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically. CC.2.3.K.A.1: Identify and describe two- and three-dimensional shapes. CC.2.3.K.A.2: Analyze, compare, create, and compose two- and three-dimensional shapes.
PA Standards: Social Studies	5.1.K.E: Demonstrate responsibilities in the classroom.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-1C: Demonstrate that creating can be done by anyone.

Kindergarten

3.3.K.A Earth and Space Sciences: Earth's Systems

Students who demonstrate understanding can *use and share observations of local weather conditions to describe patterns over time.*

Clarifying Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.

Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. - Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. Connections to Nature of Science Science Knowledge Is Based on Empirical Evidence - Scientists look for patterns and order when making observations about the world.	Weather and Climate Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.	Patterns Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

Pennsylvania Context: Examples of Pennsylvania context include that Pennsylvania has four distinct seasons.

PA Career Ready Skills: Interact in pro-social ways (e.g., reciprocal conversation, turn taking, sharing) with peers and adults.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.E. Organizing and analyzing information: Learners describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.
PA Core Standards: ELA	CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.K.A.1: Describe and compare attributes of length, area, weight, and capacity of everyday objects. CC.2.4.K.A.4: Classify objects and count the number of objects in each category.
PA Standards: Social Studies	7.3.K.A: Describe how weather affects daily life.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3A: Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.

Kindergarten

3.3.K.B Earth and Space Sciences: Earth's Systems

Students who demonstrate understanding can *construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.*

Clarifying Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). Construct an argument with evidence to support a claim.	Biogeology - Plants and animals can change their environment. Human Impacts on Earth Systems - Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.	Systems and System Models Systems in the natural and designed world have parts that work together.

Pennsylvania Context: Examples of Pennsylvania context include that Pennsylvania has many examples of how animals, plants, and humans alter and impact the environment to meet their survival needs.

PA Career Ready Skills: Identify similarities and differences between self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.
PA Core Standards: ELA	CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others. CC.2.4.K.A.1: Describe and compare attributes of length, area, weight, and capacity of everyday objects. CC.2.4.K.A.4: Classify objects and count the number of objects in each category.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	6.1.K.C: Identify choices to meet needs.
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-1A: Compare the natural world and human-made world.

Kindergarten

3.3.K.C Earth and Space Sciences: Earth and Human Activity

Students who demonstrate understanding can *use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.*

Clarifying Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions. Use and/or develop a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).	Natural Resources Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.	Systems and System Models Systems in the natural and designed world have parts that work together.

Pennsylvania Context: Examples of Pennsylvania context include a wide variety of habitats from mountains to urban areas, each of which provides the specific food, shelter, water, and space required by the variety of plants and animals found in each habitat. Local nature centers can provide information on the types of native Pennsylvania wildlife and native wild plants that can be found in each region of the state.

PA Career Ready Skills: Identify similarities and differences between self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.F. Working with models and simulations: Learners use models to represent environmental relationships, patterns, and processes.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.5.K.A: Participate in collaborative conversations with peers and adults in small and larger groups. CC.1.5.K.C: Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.K.A.1: Know number names and write and recite the count sequence.
PA Standards: Social Studies	6.4.K.D: Identify individual wants and needs. 7.3.K.A: Describe how weather affects daily life.
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-3B: Draw connections between technology and human experiences.

Kindergarten

3.3.K.D Earth and Space Sciences: Earth and Human Activity

Students who demonstrate understanding can ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.

Clarifying Statement: Emphasis is on local forms of severe weather.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. - Ask questions based on observations to find more information about the natural and/or designed world(s). Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. - Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.	Natural Hazards - Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. Defining and Delimiting an Engineering Problem - Asking questions, making observations, and gathering information are helpful in thinking about problems.	Cause and Effect - Events have causes that generate observable patterns. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - People encounter questions about the natural world every day. Influence of Engineering, Technology, and Science on Society and the Natural World - People depend on various technologies in their lives; human life would be very different without technology.

Pennsylvania Context: Examples of Pennsylvania context include identifying severe weather in your area (e.g., tornadoes, forest fires, flooding, blizzards) and how forecasting helps one prepare to ensure safety.

PA Career Ready Skills: Engage in reciprocal communication with peers and adults.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.c: Evaluate the importance of technology use and how it impacts AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.A. Questioning: Learners develop questions that help them conduct simple investigations and learn about the environment.
PA Core Standards: ELA	CC.1.5.K.A: Participate in collaborative conversations with peers and adults in small and larger groups. CC.1.5.K.C: Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.K.A.1: Know number names and write and recite the count sequence.
PA Standards: Social Studies	7.3.K.A: Describe how weather affects daily life.
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-1B: Explain the tools and techniques that people use to help them do things.

Kindergarten

3.3.K.E Earth and Space Sciences: Earth and Human Activity

Students who demonstrate understanding can *communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*

Clarifying Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. Communicate information with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.	Human Impacts on Earth Systems - Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. Developing Possible Solutions - Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Cause and Effect Events have causes that generate observable patterns.

Pennsylvania Context: Examples of Pennsylvania context include habitat destruction, and industrial operations, or examples of how humans affect the environment by their actions. Wastewater treatment, landfills, and recycling centers provide additional context.

PA Career Ready Skills: Engage in reciprocal communication with peers and adults.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 3.1.C. Identifying and critiquing alternative solutions and courses of action: Learners develop plans, including possible design solutions, for addressing selected local environmental issues.
PA Core Standards: ELA	CC.1.5.K.A: Participate in collaborative conversations with peers and adults in small and larger groups.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.K.A.1: Know number names and write and recite the count sequence.
PA Standards: Social Studies	5.2.K.B: Identify a problem and discuss possible solutions.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-4B: Illustrate helpful and harmful effects of technology.

Grade 1

3.1.1.A Life Science: From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.

Clarifying Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.	Structure and Function - All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. Information Processing - Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.	Structure and Function - The shape and stability of structures of natural and designed objects are related to their function(s). Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering and Technology on Society and the Natural World - Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.

Pennsylvania Context: Examples of Pennsylvania context include adaptations of Pennsylvania-recognized organisms such as hemlock, mountain laurel, and white-tailed deer.

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR work-places or scenarios using technology.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.
PA Core Standards: ELA	CC.1.4.1.V: Participate in individual or shared research and writing projects. CC.1.5.1.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	CC.2.1.1.B.2: Use place value concepts to represent amounts of tens and ones and to compare two digit numbers. CC.2.4.1.A.4: Represent and interpret data using tables/charts.
PA Standards: Social Studies	6.5.1.E: Describe what tools (tangible assets) are necessary to complete a task.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-4E: Design new technologies that could improve their daily lives.

Grade 1**3.1.1.B Life Science:** From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can *read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.*

Clarifying Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.	Growth and Development of Organisms Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.	Patterns Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence Scientists look for patterns and order when making observations about the world.		

Pennsylvania Context: Examples of Pennsylvania context include Pennsylvania flora and fauna.

PA Career Ready Skills: Explain ways to establish relationships that are positive and supportive of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.C. Collecting information: Learners locate and collect information about the environment and environmental topics.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.1.A: Identify the main idea and retell key details of text. CC.1.2.1.B: Ask and answer questions about key details in a text. CC.1.2.1.L: Read and comprehend literary non-fiction and informational text on grade level, reading independently and proficiently. CC.1.4.1.V: Participate in individual or shared research and writing projects.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.1.B.2: Use place value concepts to represent amounts of tens and ones and to compare two digit numbers. CC.2.4.1.A.4: Represent and interpret data using tables/charts.
PA Standards: Social Studies	8.3.1.D: Identify conflict and describe ways to cooperate with others by making smart choices.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3A: Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.

Grade 1**3.1.1.C Life Science:** Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can *make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.*

Clarifying Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.

Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	Inheritance of Traits - Young animals are very much, but not exactly like, their parents. Plants also are very much, but not exactly, like their parents. Variation of Traits - Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.	Patterns Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Pennsylvania Context: Examples of Pennsylvania context include examples of native Pennsylvania animals and plants.

PA Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.E. Organizing and analyzing information: Learners describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.
PA Core Standards: ELA	CC.1.4.1.V: Participate in individual or shared research and writing projects. CC.1.4.1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically. CC.2.4.1.A.1: Order lengths and measure them both indirectly and by repeating length units.
PA Standards: Social Studies	8.3.1.C: Identify examples of change.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3A: Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.

Grade 1**3.2.1.A Physical Science:** Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can *plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.*

Clarifying Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Plan and conduct investigations collaboratively to produce evidence to answer a question.	Wave Properties Sound can make matter vibrate, and vibrating matter can make sound.	Cause and Effect Simple tests can be designed to gather evidence to support or refute student ideas about causes.
Connections to Nature of Science Scientific Investigations Use a Variety of Methods - Science investigations begin with a question. - Scientists use different ways to study the world.		

Pennsylvania Context: N/A

PA Career Ready Skills: Distinguish among a set of short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.B. Designing investigations: Learners design simple environmental investigations.
PA Core Standards: ELA	CC.1.4.1.A: Write informative/explanatory texts to examine a topic and convey ideas and information. CC.1.4.1.V: Participate in individual or shared research and writing projects. CC.1.4.1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.5.1.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically. CC.2.4.1.A.1: Order lengths and measure them both indirectly and by repeating length units.
PA Standards: Social Studies	6.5.1.E: Describe what tools (tangible assets) are necessary to complete a task.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-2D: Develop a plan in order to complete a task.

Grade 1**3.2.1.B Physical Science:** Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can *make observations to construct an evidence-based account that objects can be seen only when illuminated.*

Clarifying Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	Electromagnetic Radiation Objects can be seen if light is available to illuminate them or if they give off their own light.	Cause and Effect Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Pennsylvania Context: Examples of Pennsylvania context include Pennsylvania's cave systems and mines.

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.03.03.04.c: Create a plan to mitigate the level of contamination or injury identified as a risk in the workplace.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.C. Collecting information: Learners locate and collect information about the environment and environmental topics.
PA Core Standards: ELA	CC.1.4.1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.5.1.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically. CC.2.4.1.A.1: Order lengths and measure them both indirectly and by repeating length units.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	5.4.1.B: Describe how classrooms can work together.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-2B: Safely use tools to complete tasks.

Grade 1**3.2.1.C Physical Science:** Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can *plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.*

Clarifying Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).

Assessment Boundary: Assessment does not include the speed of light.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.	Electromagnetic Radiation Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.)	Cause and Effect Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Pennsylvania Context: N/A

PA Career Ready Skills: Distinguish among a set of short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.B. Designing investigations: Learners design simple environmental investigations.
PA Core Standards: ELA	CC.1.4.1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.5.1.A: Participate in collaborative conversations with peers and adults in small and larger groups.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically. CC.2.4.1.A.1: Order lengths and measure them both indirectly and by repeating length units.
PA Standards: Social Studies	6.5.1.E: Describe what tools (tangible assets) are necessary to complete a task.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-2C: Explain that materials are selected for use because they possess desirable properties and characteristics.

Grade 1**3.2.1.D Physical Science:** Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can *use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*

Clarifying Statement: Examples of devices could include a light source to send signals, paper cup and string “telephones,” and a pattern of drum beats.

Assessment Boundary: Assessment does not include technological details for how communication devices work.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.	Information Technologies and Instrumentation People also use a variety of devices to communicate (send and receive information) over long distances.	Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science, on Society and the Natural World People depend on various technologies in their lives; human life would be very different without technology.

Pennsylvania Context: N/A

PA Career Ready Skills: Distinguish among a set of short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.G. Drawing conclusions and developing explanations: Learners develop explanations that address their questions about the environment.
PA Core Standards: ELA	CC.1.4.1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.5.1.A: Participate in collaborative conversations with peers and adults in small and larger groups.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically. CC.2.4.1.A.1: Order lengths and measure them both indirectly and by repeating length units.
PA Standards: Social Studies	6.5.1.E: Describe what tools (tangible assets) are necessary to complete a task.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-2B: Safely use tools to complete tasks. STEL-5B: Explore how technologies are developed to meet individual and societal needs and wants.

Grade 1**3.3.1.A Earth and Space Sciences:** Earth's Place in the Universe

Students who demonstrate understanding can *use observations of the sun, moon, and stars to describe patterns that can be predicted.*

Clarifying Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.

Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	The Universe and Its Stars Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.	Patterns - Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes natural events happen today as they happened in the past. - Many events are repeated.

Pennsylvania Context: N/A

PA Career Ready Skills: Distinguish among a set of short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.C. Collecting information: Learners locate and collect information about the environment and environmental topics.
PA Core Standards: ELA	CC.1.4.1.V: Participate in individual or shared research and writing projects. CC.1.4.1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.5.1.A: Participate in collaborative conversations with peers and adults in small and larger groups.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.1.A.4: Represent and interpret data using tables/charts.
PA Standards: Social Studies	8.3.1.C: Identify examples of change.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-1A: Compare the natural world and human-made world.

Grade 1**3.3.1.B Earth and Space Sciences:** Earth's Place in the Universe

Students who demonstrate understanding can *Make observations at different times of year to relate the amount of daylight to the time of year.*

Clarifying Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.

Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Make observations (firsthand or from media) to collect data that can be used to make comparisons.	Earth and the Solar System Seasonal patterns of sunrise and sunset can be observed, described, and predicted.	Patterns Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

Pennsylvania Context: Examples of Pennsylvania context include that Pennsylvania has four distinct seasons.

PA Career Ready Skills: Distinguish among a set of short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.E. Organizing and analyzing information: Learners describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.
PA Core Standards: ELA	CC.1.4.1.V: Participate in individual or shared research and writing projects. CC.1.4.1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.5.1.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically. CC.2.2.1.A.1: Represent and solve problems involving addition and subtraction within 20. CC.2.4.1.A.4: Represent and interpret data using tables/charts.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	7.3.1.A: Identify the local climate and how it determines the way people live.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-1A: Compare the natural world and human-made world.

Grade 2

3.1.2.A Life Science: Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can plan and conduct an investigation to determine if plants need sunlight and water to grow.

Clarifying Statement: N/A

Assessment Boundary: Assessment is limited to testing one variable at a time.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.	Interdependent Relationships in Ecosystems Plants depend on water and light to grow.	Cause and Effect Events have causes that generate observable patterns.

Pennsylvania Context: Examples of Pennsylvania context include Pennsylvania native plants and agricultural products.

PA Career Ready Skills: Distinguish among a set of short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.B. Designing investigations: Learners design simple environmental investigations.
PA Core Standards: ELA	CC.1.4.2.V: Participate in individual or shared research and writing projects. CC.1.5.2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.2.A.1: Measure and estimate lengths in standard units using appropriate tools. CC.2.4.2.A.4: Represent and interpret data using line plots, picture graphs, and bar graphs.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	5.1.2.C: Define fairness in working with others. 7.2.2.A: Identify the physical characteristics of places.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-2E: Collaborate effectively as a member of a team.

Grade 2

3.1.2.B Life Science: Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.

Clarifying Statement: N/A

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. Develop a simple model based on evidence to represent a proposed object or tool.	Interdependent Relationships in Ecosystems - Plants depend on animals for pollination or to move their seeds around. Developing Possible Solutions - Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Structure and Function The shape and stability of structures of natural and designed objects are related to their function(s).

Pennsylvania Context: Examples of Pennsylvania context include plants commonly found in Pennsylvania.

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.F. Working with models and simulations: Learners use models to represent environmental relationships, patterns, and processes.
PA Core Standards: ELA	CC.1.4.2.V: Participate in individual or shared research and writing projects. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.2.A: Participate in collaborative conversations with peers and adults in small and larger groups. CC.1.5.2.E: Add drawings or other visual displays to presentations when appropriate to clarify ideas, thoughts, and feelings.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.2.A.4: Represent and interpret data using line plots, picture graphs, and bar graphs.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	6.5.2.E: Describe the qualities that may be necessary to complete a task.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2A: Illustrate how systems have parts or components that work together to accomplish a goal.

Grade 2**3.1.2.C Life Science:** Biological Evolution: Unity and Diversity

Students who demonstrate understanding can *make observations of plants and animals to compare the diversity of life in different habitats.*

Clarifying Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.

Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. - Make observations (firsthand or from media) to collect data that can be used to make comparisons. Connections to Nature of Science Scientific Knowledge Is Based on Empirical Evidence - Scientists look for patterns and order when making observations about the world.	Biodiversity and Humans There are many different kinds of living things in any area, and they exist in different places on land and in water.	N/A

Pennsylvania Context: Examples of Pennsylvania context could include the diverse habitats across Pennsylvania from wetlands and forests to urban habitats such as cemeteries, parks, and subterranean locations.

PA Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.C. Collecting information: Learners locate and collect information about the environment and environmental topics.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.2.V: Participate in individual or shared research and writing projects. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.2.A.4: Represent and interpret data using line plots, picture graphs, and bar graphs.
PA Standards: Social Studies	7.3.2.A: Identify the effect of local geography on the residents of the region. (e.g., food, clothing, industry, trade, types of shelter, etc.)
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-1A: Compare the natural world and human-made world.

Grade 2**3.2.2.A Physical Science: Matter and Its Interactions**

Students who demonstrate understanding can *plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.*

Clarifying Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.	Structure and Properties of Matter Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.	Patterns Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.B. Designing investigations: Learners design simple environmental investigations. K-4 Strand 2.1.A. Earth's physical systems: Learners describe characteristics of Earth's physical systems, including air, water, and land. They explain how these systems interact with one another and identify changes in the physical environment over time. They provide examples of how physical systems affect living organisms, including humans.
PA Core Standards: ELA	CC.1.4.2.V: Participate in individual or shared research and writing projects. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.2.A: Participate in collaborative conversations with peers and adults in small and larger groups.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.6: Attend to precision. CC.2.4.2.A.4: Represent and interpret data using line plots, picture graphs, and bar graphs. CC.2.3.2.A.1: Analyze and draw two and three-dimensional shapes having specified attributes.
PA Standards: Social Studies	5.1.2.C: Define fairness in working with others.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-2C: Explain that materials are selected for use because they possess desirable properties and characteristics.

Grade 2**3.2.2.B Physical Science:** Matter and its Interactions

Students who demonstrate understanding can *analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*

Clarifying Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.

Assessment Boundary: Assessment of quantitative measurements is limited to length.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Analyze data from tests of an object or tool to determine if it works as intended.	Structure and Properties of Matter Different properties are suited to different purposes.	Cause and Effect - Simple tests can be designed to gather evidence to support or refute student ideas about causes. Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science, on Society and the Natural World - Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	C3.06.04.02.c: Evaluate and select appropriate tools and equipment to complete AFNR tasks.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.1.A. Earth's physical systems: Learners describe characteristics of Earth's physical systems, including air, water, and land. They explain how these systems interact with one another and identify changes in the physical environment over time. They provide examples of how physical systems affect living organisms, including humans.
PA Core Standards: ELA	CC.1.4.2.V: Participate in individual or shared research and writing projects. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically. CC.2.4.2.A.4: Represent and interpret data using line plots, picture graphs, and bar graphs.
PA Standards: Social Studies	6.1.2.C: Explain how choice has consequences.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-2C: Explain that materials are selected for use because they possess desirable properties and characteristics.

Grade 2**3.2.2.C Physical Science:** Matter and Its Interactions

Students who demonstrate understanding can *make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.*

Clarifying Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	Structure and Properties of Matter - Different properties are suited to different purposes. - A great variety of objects can be built up from a small set of pieces.	Energy and Matter Objects may break into smaller pieces and be put together into larger pieces, or change shapes.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.C. Collecting information: Learners locate and collect information about the environment and environmental topics. K-4 Strand 1.G. Drawing conclusions and developing explanations: Learners develop explanations that address their questions about the environment.
PA Core Standards: ELA	CC.1.4.2.V: Participate in individual or shared research and writing projects. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.2.A: Participate in collaborative conversations with peers and adults in small and larger groups.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.7: Look for and make use of structure. CC.2.4.2.A.4: Represent and interpret data using line plots, picture graphs, and bar graphs.
PA Standards: Social Studies	5.2.2.B: Identify a problem and a probable solution.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-2A: Illustrate how systems have parts or components that work together to accomplish a goal.

Grade 2**3.2.2.D Physical Science:** Matter and Its Interactions

Students who demonstrate understanding can *construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.*

Clarifying Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). - Construct an argument with evidence to support a claim. Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena - Science searches for cause and effect relationships to explain natural events.	Chemical Reactions Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.	Cause and Effect Events have causes that generate observable patterns.

Pennsylvania Context: N/A

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.G. Drawing conclusions and developing explanations: Learners develop explanations that address their questions about the environment.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.2.V: Participate in individual or shared research and writing projects. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.3: Construct viable arguments and critique the reasoning of others. CC.2.4.2.A.4: Represent and interpret data using line plots, picture graphs, and bar graphs.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-8A: Analyze how things work.

Grade 2**3.3.2.A Earth and Space Sciences:** Earth's Place in the Universe

Students who demonstrate understanding can *use information from several sources to provide evidence that Earth events can occur quickly or slowly.*

Clarifying Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.

Assessment Boundary: Assessment does not include quantitative measurements of timescales.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	The History of Planet Earth Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.	Stability and Change Things may change slowly or rapidly.

Pennsylvania Context: Examples of Pennsylvania context include local examples of weathering and erosion.

PA Career Ready Skills: Distinguish among and set short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.E. Organizing and analyzing information: Learners describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.
PA Core Standards: ELA	CC.1.2.2.B: Ask and answer questions such as who, what, where, when, why, and how to demonstrate understanding of key details in a text. CC.1.2.2.C: Describe the connection between a series of events, concepts, or steps in a procedure within a text.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically. CC.2.1.2.B.1: Use place value concepts to represent amounts of tens and ones and to compare three digit numbers.
PA Standards: Social Studies	8.1.2.C: Apply sources of historical information.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3A: Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.

Grade 2**3.3.2.B Earth and Space Sciences: Earth's Systems**

Students who demonstrate understanding can *compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*

Clarifying Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Generate and/or compare multiple solutions to a problem.	Earth Materials and Systems Wind and water can change the shape of the land.	Stability and Change - Things may change slowly or rapidly. Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World - Developing and using technology has impacts on the natural world. Connections to Nature of Science Science Addresses Questions About the Natural and Material World - Scientists study the natural and material world.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.c: Evaluate the importance of technology use and how it impacts AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.3.A. Human-environment interactions: Learners identify ways that people depend on, change, and are affected by the environment.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.2.C: Describe the connection between a series of events, concepts, or steps in a procedure within a text. CC.1.5.2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically. CC.2.3.2.A.1: Analyze and draw two and three-dimensional shapes having specified attributes.
PA Standards: Social Studies	5.2.2.B: Identify a problem and a probable solution.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-7E: Illustrate that there are different solutions to a design and that none are perfect.

Grade 2**3.3.2.C Earth and Space Sciences:** Earth's Systems

Students who demonstrate understanding can *develop a model to represent the shapes and kinds of land and bodies of water in an area.*

Clarifying Statement: N/A

Assessment Boundary: Assessment does not include quantitative scaling in models.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. Use and/or develop a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).	Plate Tectonics and Large-Scale System Interactions Maps show where things are located. One can map the shapes and kinds of land and water in any area.	Patterns Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Pennsylvania Context: Examples of Pennsylvania context include Pennsylvania's dams and levees.

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.c: Evaluate geographic data and select necessary data sets to solve problems within AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.F. Working with models and simulations: Learners use models to represent environmental relationships, patterns, and processes.
PA Core Standards: ELA	CC.1.2.2.C: Describe the connection between a series of events, concepts, or steps in a procedure within a text.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically. CC.2.3.2.A.1: Analyze and draw two- and three-dimensional shapes having specified attributes. CC.2.4.2.A.6: Extend the concepts of addition and subtraction to problems involving length.
PA Standards: Social Studies	7.2.2.A: Identify the physical characteristics of places.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-7G: Apply skills necessary for making in design.

Grade 2**3.3.2.D Earth and Space Sciences: Earth's Systems**

Students who demonstrate understanding can *obtain information to identify where water is found on Earth and that it can be solid or liquid.*

Clarifying Statement: N/A

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question.	The Roles of Water in Earth's Surface Processes Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.	Patterns Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Pennsylvania Context: N/A

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 2.1.A. Earth's physical systems: Learners describe characteristics of Earth's physical systems, including air, water, and land. They explain how these systems interact with one another and identify changes in the physical environment over time. They provide examples of how physical systems affect living organisms, including humans.
PA Core Standards: ELA	CC.1.2.2.C: Describe the connection between a series of events, concepts, or steps in a procedure within a text. CC.1.5.2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.2.B.2: Use place value concepts to read, write and skip count to 1000.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	7.2.2.A: Identify the physical characteristics of places.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3A: Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.

Grades K–2

3.4.K-2.A Environmental Literacy and Sustainability: Agriculture and Environmental Systems and Resources

Students who demonstrate understanding can *categorize ways people harvest, re-distribute, and use natural resources.*

Clarifying Statement: Examples could include that trees provide food, fiber, and building materials. Trees are logged, transported, and processed into different products, such as fiber, furniture, and buildings. Fruits and nuts from trees are picked, transported, and processed.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. - Communicate information with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. - Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	Natural Resources Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.	Cause and Effect - Events have causes that generate observable patterns. Systems and System Models - Systems in the natural and designed world have parts that work together.

Pennsylvania Context: Examples of Pennsylvania context include Pennsylvania farms (agriculture, urban agriculture, and aquaculture), businesses (manufacturing, recreation), and industries (electricity and power, mining, biotechnology, forest products, transportation).

PA Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.a: Define stewardship of natural resources and distinguish how it connects to AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.3.B. Resource distribution and consumption: Learners describe ways people harvest, re-distribute, and use natural resources.
PA Core Standards: ELA	CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K.B: Ask and answer questions about key details in a text read aloud or information presented orally or through other media. CC.1.5.1.B: Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood. CC.1.5.2.B: Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.1.A.4: Represent and interpret data using tables/charts. CC.2.4.2.A.4: Represent and interpret data using line plots, picture graphs, and bar graphs.
PA Standards: Social Studies	5.2.2.D: Explain responsible community behavior. 6.2.2.G: Identify examples of an economic system.
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-4D: Select ways to reduce, reuse, and recycle resources in daily life. Children should give examples of the ways they handle waste at school or at home.

Grades K–2**3.4.K-2.B Environmental Literacy and Sustainability:** Agriculture and Environmental Systems and Resources

Students who demonstrate understanding can *examine how people from different cultures and communities, including one's own, interact and express their beliefs about nature.*

Clarifying Statement: Emphasis is on how students' interactions and beliefs about nature compare to someone living in a different community. Emphasis is not on judging anyone's interactions or beliefs about nature.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.	Natural Resources - Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. Human Impacts on Earth Systems - Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.	Patterns - Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. Cause and Effect - Events have causes that generate observable patterns.

Pennsylvania Context: N/A

PA Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.01.01.b: Analyze and summarize AFNR issues and their impact on local, state, national and global levels.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.2.B. Culture: Learners identify ways that people express different cultural backgrounds and how these can influence environmental perceptions and activities.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K.B: Ask and answer questions about key details in a text read aloud or information presented orally or through other media. CC.1.5.1.B: Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood. CC.1.5.2.B: Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.5: Use appropriate tools strategically. CC.2.4.1.A.4: Represent and interpret data using tables/charts.
PA Standards: Social Studies	6.1.K.A: Identify how scarcity influences choice. 8.2.1.C: Identify holiday and cultural celebrations in a community and why they are celebrated. 8.4.1.A: Explain why cultures celebrate.
Educational Technology (ISTE)	1.7. Global Collaborator: Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.
Technology and Engineering (ITEEA)	STEL-1A: Compare the natural world and human-made world.

Grades K–2**3.4.K-2.C Environmental Literacy and Sustainability:** Environmental Literacy Skills

Students who demonstrate understanding can *explain ways that places differ in their physical characteristics, their meaning, and their value and/or importance.*

Clarifying Statement: Emphasis is on making observations of local environments such as schoolyards, streams, mountains, and fields and sharing their value or meaning. Examples of value or meaning could be their recreational, esthetic (aesthetic), economic, and ecological importance, such as providing a home for animals.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. - Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. - Communicate information with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.	Biodiversity and Humans - There are many different kinds of living things in any area, and they exist in different places on land and in water. Human Impacts on Earth Systems - Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.	Patterns - Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. Stability and Change - Things may change slowly or rapidly.

Pennsylvania Context: Examples of Pennsylvania context include the state's geographic features, which include but are not limited to mountain ranges, forested areas, waterways, watersheds, marshes, farms, cities, and developed areas.

PA Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.c: Evaluate geographic data and select necessary data sets to solve problems within AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.3.C. Places: Learners identify ways that places differ in their physical and human characteristics.
PA Core Standards: ELA	CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups. CC.1.5.K.D: Share stories, familiar experiences, and interests, speaking clearly enough to be understood by all audiences using appropriate volume. CC.1.5.1.D: Describe people, places, things, and events with relevant details, expressing ideas and feelings clearly. CC.1.5.2.D: Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent sentences.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically. CC.2.4.2.A.4: Represent and interpret data using line plots, picture graphs, and bar graphs.
PA Standards: Social Studies	7.1.1.B: Describe places in geographic reference in physical features.
Educational Technology (ISTE)	1.7. Global Collaborator: Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.
Technology and Engineering (ITEEA)	STEL-1A: Compare the natural world and human-made world.

Grades K–2**3.4.K-2.D Environmental Literacy and Sustainability:** Environmental Literacy Skills

Students who demonstrate understanding can *plan and carry out an investigation to address an issue in their local environment and community.*

Clarifying Statement: Examples of planning could include developing questions (“wonder statements”) about a local environment issue (such as litter, discolored streams, erosion) and then letting students decide how to answer them.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers.	Human Impacts on Earth Systems Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.	Stability and Change - Things may change slowly or rapidly. Patterns - Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local nature centers, Pennsylvania’s Conservation Districts, and science museums and centers.

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR workplaces or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 3.2.C. Planning and taking action: Learners develop an action strategy or design solution for a specific local environmental issue of their choosing.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.1.F: Add drawings or other visual displays when sharing aloud to clarify ideas, thoughts, and feelings. CC.1.5.2.F: Add drawings or other visual displays to presentations when appropriate to clarify ideas, thoughts, and feelings.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.1.A.4: Represent and interpret data using tables/charts. CC.2.4.2.A.4: Represent and interpret data using line plots, picture graphs, and bar graphs.
PA Standards: Social Studies	5.1.1.E: Describe students' responsibilities in the school and community. 5.1.2.C: Define fairness in working with others. 5.2.2.C: Identify community projects/activities that support leadership and public service.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-2D: Develop a plan in order to complete a task.

Grades K–2

3.5.K-2.A Technology and Engineering: Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can *identify and use everyday symbols*.

Clarifying Statement: Symbols are used as a means of communication in the technological world. Examples include road signs, symbols for persons with disabilities, and icons on a screen.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Analyze data from tests of an object or tool to determine if it works as intended.	Developing Possible Solutions Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Communication Learns that humans have many ways to communicate.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environmental Literacy & Sustainability, and Technology & Engineering Standards Grades K–12	N/A

Grades K–2**3.5.K-2.B Technology and Engineering:** Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can *describe qualities of everyday products.*

Clarifying Statement: Technology assessment, or the ability to critically analyze a technology's effectiveness, is a skill that should be introduced early and consistently. Is a lunchbox hard or soft, metal or plastic, insulated or not? Is there enough space inside for the items brought for lunch?

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Ask questions based on observations to find more information about the natural and/or designed world(s).	Structure and Properties of Matter Different properties are suited for different purposes.	Communication Learns that humans have many ways to communicate.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

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Standards

N/A

Grades K–2**3.5.K-2.C Technology and Engineering:** Impacts of Technology

Students who demonstrate understanding can *explain ways that technology helps with everyday tasks.*

Clarifying Statement: Children should be able to identify activities they engage in regularly and describe how different technologies help them do these tasks more easily. Contrasting the lifestyles of earlier societies with their own will provide ample examples.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Defining and Delimiting Engineering Problems Asking questions, making observations, and gathering information are helpful in thinking about problems.	Communication Learns that humans have many ways to communicate.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

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Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.D Technology and Engineering:** Impacts of Technology

Students who demonstrate understanding can *select ways to reduce, reuse, and recycle resources in daily life.*

Clarifying Statement: Children should give examples of the ways they handle waste at school or at home.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Human Impacts on Earth Systems - Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. Developing Possible Solutions - Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Attention to Ethics Learns that use of technology affects humans and the environment.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to waste removal and recycling facilities.

Pennsylvania Career Ready Skills: Select coping skill strategies response to adverse situations (e.g., positive self-talk, talking to others, taking a break, taking care of oneself, avoiding negative self-talk).

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades K–2**3.5.K-2.E Technology and Engineering:** Impacts of Technology

Students who demonstrate understanding can *illustrate helpful and harmful effects of technology.*

Clarifying Statement: Children can examine a familiar technology and explain how it can be both helpful and harmful. For example, a crayon can be used to draw creatively but can also be used to write on bedroom walls.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	N/A	Communication - Learns that humans have many ways to communicate. Attention to Ethics - Learns that use of technology affects humans and the environment.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

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Standards**

3.3.2.B: Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

Grades K–2**3.5.K-2.F Technology and Engineering:** Influence of Society on Technological Development

Students who demonstrate understanding can *investigate the use of technologies in the home and community.*

Clarifying Statement: Children learn to use their senses to gather data and make observations about technologies in their everyday environment. Toasters, microwaves, stoves, and refrigerators may be used to create breakfasts before going to school in western cultures. In other societies, different food storage and preparation technologies are used for this same purpose.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Defining and Delimiting Engineering Problems Asking questions, making observations, and gathering information are helpful in thinking about problems.	Critical Thinking Engages in listening, questioning, and discussing.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's food production industries.

Pennsylvania Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

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3.2.1.C: Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.

Grades K–2**3.5.K-2.G Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *explain the tools and techniques that people use to help them do things.*

Clarifying Statement: By using technology and engineering, people adapt the natural world to meet their needs and wants and to solve problems. All people use tools and processes created through technology and engineering in every aspect of their daily tasks.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Defining and Delimiting Engineering Problems - A situation that people want to change or create can be approached as a problem to be solved through engineering. - Asking questions, making observations, and gathering information are helpful in thinking about problems. - Before beginning to design a solution, it is important to clearly understand the problem.	Critical Thinking Engages in listening, questioning, and discussing.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

**Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards**

N/A

Grades K–2**3.5.K-2.H Technology and Engineering:** Influence of Society on Technological Development

Students who demonstrate understanding can *explain the needs and wants of individuals and societies.*

Clarifying Statement: Basic human needs include food, water, and shelter. Beyond these, children can discuss other needs and wants that have resulted in new technologies. This helps them to begin to see that other people's thoughts, feelings, needs, and wants may differ from their own.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Defining and Delimiting Engineering Problems A situation that people want to change or create can be approached as a problem to be solved through engineering.	Communication Learns that humans have many ways to communicate.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify possible behaviors and anticipate reactions in response to a specific social context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.I Technology and Engineering:** Impacts of Technology

Students who demonstrate understanding can *compare simple technologies to evaluate their impacts.*

Clarifying Statement: Children can look at simple tools in their home or school to compare how they impact life. For example, how does a hand-operated pencil sharpener versus an electric one impact people?

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Optimizing the Design Solution Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	Critical Thinking Engages in listening, questioning, and discussing.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

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Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.J Technology and Engineering:** Impacts of Technology

Students who demonstrate understanding can *design new technologies that could improve their daily lives.*

Clarifying Statement: Children can brainstorm needs or wants and devise possible solutions to meet a need. Teachers and parents can pose “what if?” questions to young children. “What if you and your friends could build something in the school’s playground to make recess more fun? What would you build?”

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.	Defining and Delimiting Engineering Problems A situation that people want to change or create can be approached as a problem to be solved through engineering.	Making and Doing Learns to use tools and materials to accomplish a task.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify one’s own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.

PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	3.3.2.B: Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

Grades K–2**3.5.K-2.K Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *safely use tools to complete tasks.*

Clarifying Statement: Many tools have specific functions and selecting the right tool makes the task easier. People use tools to make objects, to achieve a desired outcome, and to communicate. Children use scissors to cut paper, glue sticks to fasten components together, markers to sketch ideas, and computers to search for information.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.	N/A	Making and Doing Learns to use tools and materials to accomplish a task.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)

PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades K–2**3.5.K-2.L Technology and Engineering:** Influence of Society on Technological Development

Students who demonstrate understanding can *explore how technologies are developed to meet individual and societal needs and wants.*

Clarifying Statement: For example, people need clean, safe water, so systems are developed to provide water to homes and schools. Human-made technology requires some knowledge of the natural world and uses materials from it as well.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Defining and Delimiting Engineering Problems Before beginning to design a solution, it is important to clearly understand the problem.	Systems Thinking Learns that human-designed things are connected.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Respond to others given a sense of the others' point of view.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.M Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *demonstrate essential skills of the engineering design process.*

Clarifying Statement: Young children identify that there are some essential skills, such as creative thinking, building, and testing, that are required to succeed in technology and engineering design.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.	Developing Possible Solutions Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Creativity - Learns that humans create products and ways of doing things. Making and Doing - Learns to use tools and materials to accomplish a task. Collaboration - Learns to share technological products and ideas.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Explain ways to establish relationships that are positive and supportive of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.

PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades K–2**3.5.K-2.N Technology and Engineering:** Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can *analyze how things work*.

Clarifying Statement: This can be done by safely and carefully taking something apart and then putting it back together. The ability to observe, analyze, and document is vital to successfully accomplishing this task.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Defining and Delimiting Engineering Problems Before beginning to design a solution, it is important to clearly understand the problem.	Critical Thinking Engages in listening, questioning, and discussing.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics.

Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.O Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *illustrate that there are different solutions to a design and that none are perfect.*

Clarifying Statement: Young children recognize that there is more than one plausible solution to a design challenge.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Generate and/or compare multiple solutions to a problem.	Defining and Delimiting Engineering Problems A situation that people want to change or create can be approached as a problem to be solved through engineering.	Optimism Sees opportunities for making technologies better.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

**Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards**

3.2.1.A: Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.

Grades K–2**3.5.K-2.P Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *discuss that all designs have different characteristics that can be described.*

Clarifying Statement: Young children recognize and categorize basic features of design, which represent principles and elements of design. In drawing, they begin to differentiate between lines, colors, and shapes. In thinking about early ideas on design, they might brainstorm with other children, draw sketches, and see how well their ideas worked out.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Generate and/or compare multiple solutions to a problem.	Developing Possible Solutions Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Communication Learns that humans have many ways to communicate.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.

PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades K–2**3.5.K-2.Q Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *apply skills necessary for making in design.*

Clarifying Statement: Providing opportunities to use tools and manipulate materials can facilitate making skills in young children. Structuring design experiences at this age may take the form of tinkering and play.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.	Developing Possible Solutions Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Making and Doing Learns to use tools and materials to accomplish a task.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.

PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades K–2**3.5.K-2.R Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *draw connections between technology and human experiences.*

Clarifying Statement: Young children learn to count through nursery rhymes and playing with manipulatives. Children's books often include graphics and some even generate sound. Teachers can have students identify technological connections from their homes, traveling in vehicles, and other experiences, and through this help young students understand the role of technology in their lives.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	N/A	Systems Thinking Learns that human-designed things are connected.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.S Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *apply design concepts, principles, and processes through play and exploration.*

Clarifying Statement: Design experiences build on young children’s natural curiosity, desire to explore, and persistence. Familiar materials, tools, and environments will enhance these experiences.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.	Optimizing the Design Solution Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	Making and Doing - Learns to use tools and materials to accomplish a task. Creativity - Learns that humans create products and ways of doing things.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Identify possible behaviors and anticipate reactions in response to a specific social context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.

PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades K–2**3.5.K-2.T Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *demonstrate that designs have requirements.*

Clarifying Statement: Young children recognize that all designs must meet certain expectations. These expectations are related to the purpose, function, and requirements of a solution.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Generate and/or compare multiple solutions to a problem.	Defining and Delimiting Engineering Problems Before beginning to design a solution, it is important to clearly understand the problem.	Critical Thinking Engages in listening, questioning, and discussing.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania Department of Labor & Industry regulations.

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.U Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *explain that design is a response to wants and needs.*

Clarifying Statement: Young children begin to understand that design is driven by wants and needs. These wants and needs often derive from familiar environments such as home, school, and community.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Generate and/or compare multiple solutions to a problem.	Defining and Delimiting Engineering Problems Asking questions, making observations, and gathering information are helpful in thinking about problems.	Communication Learns that humans have many ways to communicate.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's food production industries.

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.V Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *explain that materials are selected for use because they possess desirable properties and characteristics.*

Clarifying Statement: Paper, wood, cloth, cardboard, and found objects are the most common materials young children use in making the items they design. By working with materials, they learn through observation and testing which materials perform better for given tasks.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Structure and Properties of Matter - Different properties are suited to different purposes. Defining Engineering Problems - A situation that people want to change or create can be approached as a problem to be solved through engineering.	Communication Learns that humans have many ways to communicate.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to waste removal and recycling facilities.

Pennsylvania Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.W Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.*

Clarifying Statement: Young children can use building blocks to develop computational and critical thinking skills by introducing design, measurement, and structural concepts. The intentional translation of skills learned in physical education, such as teamwork, can be applied to problem solving. Drawing in art class can lead to new ways of thinking about design and visual appeal.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Analyze data from tests of an object or tool to determine if it works as intended.	Defining and Delimiting Engineering Problems - A situation that people want to change or create can be approached as a problem to be solved through engineering. - Asking questions, making observations, and gathering information are helpful in thinking about problems. - Before beginning to design a solution, it is important to clearly understand the problem.	Collaboration Learns to share technological products and ideas.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's food production industries.

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.

PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	3.3.K.E: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Grades K–2**3.5.K-2.X Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *develop a plan in order to complete a task.*

Clarifying Statement: For example, young children learn that if they want to accomplish something, such as design and make a birthday card for a parent, they must have the materials available, and they must have the card ready by a given date.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Developing Possible Solutions Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Collaboration Learns to share technological products and ideas.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Distinguish among and set short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.Y Technology and Engineering:** History of Technology

Students who demonstrate understanding can *discuss how the way people live and work has changed throughout history because of technology.*

Clarifying Statement: Once people learned to provide shelter for themselves—first with simple huts and later with houses, castles, and skyscrapers—they were no longer forced to seek natural shelter, such as caves. The invention of the plow and other agricultural technologies, along with such simple devices as fish hooks and the bow and arrow, made it easier for people to feed themselves, freeing up time for other pursuits. People’s ability to communicate with one another over space and time has been improved by the use of tools and processes like smoke signals, alarms, papermaking, printing, telephones, and the internet.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Defining & Delimiting Engineering Problems Asking questions, making observations, and gathering information are helpful in thinking about problems.	Critical Thinking Engage in listening, questioning, and discussing.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grades K–2**3.5.K-2.Z Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *illustrate how systems have parts or components that work together to accomplish a goal.*

Clarifying Statement: Once people learned to provide shelter for themselves—first with simple huts and later with houses, castles, and skyscrapers—they were no longer forced to seek natural shelter, such as caves. The invention of the plow and other agricultural technologies, along with such simple devices as fish hooks and the bow and arrow, made it easier for people to feed themselves, freeing up time for other pursuits. People’s ability to communicate with one another over space and time has been improved by the use of tools and processes like smoke signals, alarms, papermaking, printing, telephones, and the internet.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions. Use and/or develop a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).	ETS1.A: Defining and Delimiting Engineering Problems A situation that people want to change or create can be approached as a problem to be solved through engineering.	Systems Thinking Learns that human-designed things are connected.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Explain ways to establish relationships that are positive and supportive of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)

PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades K–2**3.5.K-2.AA Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *demonstrate that creating can be done by anyone.*

Clarifying Statement: Using technology and engineering tools and techniques, anyone can design or improve things to enhance their lives. Creation of new knowledge, approaches, and inventions can occur through either individual or collaborative efforts. Even young children can view themselves as creators.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Defining and Delimiting Engineering Problems - A situation that people want to change or create can be approached as a problem to be solved through engineering. - Asking questions, making observations, and gathering information are helpful in thinking about problems. - Before beginning to design a solution, it is important to clearly understand the problem.	Creativity - Learns that humans create products and ways of doing things. Making and Doing - Learns to use tools and materials to accomplish a task.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

**Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards**

N/A

Grades K–2

3.5.K-2.BB Technology and Engineering: Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *compare the natural world and human-made world.*

Clarifying Statement: The natural world includes trees, plants, animals, rivers, oceans, mountains, and other items that make up the earth's landscape, biomes, and climate. The human-made world includes pencils, rulers, computers, buildings, airplanes, roads, refrigerators, communication devices, and other items developed for the betterment of humans.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	Natural Resources Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.	Systems Thinking Learns that human-designed things are connected. Critical Thinking Engages in listening, questioning, and discussing.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

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Standards**

3.2.1.C: Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.

Grades K–2**3.5.K-2.CC Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *discuss the roles of scientists, engineers, technologists and others who work with technology.*

Clarifying Statement: Technological advancement does not occur without the teamwork of many people who have knowledge and skills in distinct areas. Being able to recognize the unique contributions of these individuals is a necessary part of the technological and engineering design process. Young children can develop an appreciation of how people with different specialties can collaborate to design, create, build, and test a product or system. Analogies often work well with students in this grade band. For example, they can understand how a vehicle is purchased from a dealer, maintained by a mechanic at a service center, and driven by a family member. All of these people have something to do with the vehicle, but each in their own way.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.	N/A	Communication Learns that humans have many ways to communicate.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)

PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades K–2**3.5.K-2.DD Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *collaborate effectively as a member of a team.*

Clarifying Statement: To operate at the most effective level, team members must learn to communicate and work together as a unit. Strategies to work together in a team must be modeled by the teacher and laid out as an expectation within the laboratory-classroom setting.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Define a simple problem that can be solved through the development of a new or improved object or tool.	N/A	Collaboration Learns to share technological products and ideas.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.K.U: With guidance and support, explore a variety of digital tools to produce and publish writing or in collaboration with peers. CC.1.4.1-2.U: With guidance and support, use a variety of digital tools to produce and publish writing including in collaboration with peers. CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest. CC.1.4.1-2.V: Participate in individual or shared research and writing projects. CC.1.4.K-1.W: With guidance and support, recall information from experiences or gather information from provided sources to answer a question. CC.1.4.2.W: Recall information from experiences or gather information from provided sources to answer a question. CC.1.5.K-2.A: Participate in collaborative conversations with peers and adults in small and larger groups.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.

Science, Technology &
Engineering, and
Environmental Literacy &
Sustainability Academic
Standards

N/A

Grade 3

3.1.3.A Life Science: From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can *develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.*

Clarifying Statement: Changes organisms go through during their life form a pattern.

Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. - Use and/or develop models to describe phenomena. Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence - Science findings are based on recognizing patterns.	Growth and Development of Organisms Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.	Patterns Patterns of change can be used to make predictions.

Pennsylvania Context: Examples of Pennsylvania context include recognized species such as hemlock, mountain laurel, and white-tailed deer.

PA Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them. K-4 Strand 1.F. Working with models and simulations: Learners use models to represent environmental relationships, patterns, and processes.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.1.3.B.1: Apply place value understanding and properties of operations to perform multidigit arithmetic. CC.2.1.3.C.1: Explore and develop an understanding of fractions as numbers.
PA Standards: Social Studies	6.1.3.B: Identify needs and wants of people. Identify examples of natural, human, and capital resources.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-7L: Apply universal principles and elements of design.

Grade 3**3.1.3.B Life Science:** Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can *construct an argument that some animals form groups that help members survive.*

Clarifying Statement: N/A

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct and/or support an argument with evidence, data, and/or a model.	Social Interactions and Group Behavior Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: N/A

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.
PA Core Standards: ELA	CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others. MP.4: Model with mathematics. CC.2.1.3.B.1: Apply place value understanding and properties of operations to perform multidigit arithmetic. CC.2.1.3.C.1: Explore and develop an understanding of fractions as numbers.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	5.3.3.F: Explain how an action may be just or unjust. 5.4.3.C: Identify the role of the United Nations in the world.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-8G: Examine information to assess the trade-offs of using a product or system.

Grade 3

3.1.3.C Life Science: Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can *analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.*

Clarifying Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.

Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze and interpret data to make sense of phenomena using logical reasoning.	Inheritance of Traits - Many characteristics of organisms are inherited from their parents. Variation of Traits - Different organisms vary in how they look and function because they have different inherited information.	Patterns Similarities and differences in patterns can be used to sort and classify natural phenomena.

Pennsylvania Context: N/A

PA Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them. K-4 Strand 1.E. Organizing and analyzing information: Learners describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.3.A: Determine the main idea of a text; recount the key details and explain how they support the main idea. CC.1.2.3.B: Ask and answer questions about the text and make inferences from text; refer to text to support responses. CC.1.2.3.C: Explain how a series of events, concepts, or steps in a procedure is connected within a text, using language that pertains to time, sequence, and cause/effect. CC.1.4.3.A: Write informative/explanatory texts to examine a topic and convey ideas and information clearly. CC.1.5.3.D: Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly with adequate volume, appropriate pacing, and clear pronunciation.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.3.A.4: Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs.
PA Standards: Social Studies	7.1.3.A: Identify how basic geographic tools are used to organize and interpret information about people, places and environment.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grade 3**3.1.3.D Life Science:** Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can *use evidence to support the explanation that traits can be influenced by the environment.*

Clarifying Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., observations, patterns) to support an explanation.	Inheritance of Traits - Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. Variation of Traits - The environment also affects the traits that an organism develops.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: N/A

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.G. Drawing conclusions and developing explanations: Learners develop explanations that address their questions about the environment. K-4 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly. CC.1.5.3.D: Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly with adequate volume, appropriate pacing, and clear pronunciation.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.3: Construct viable arguments and critique the reasoning of others. CC.2.4.3.A.4: Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs.
PA Standards: Social Studies	7.4.3.A: Identify the effect of the physical systems on people within a community.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-1F: Describe the unique relationship between science and technology, and how the natural world can contribute to the human-made world to foster innovation.

Grade 3**3.1.3.E Life Science: Biological Evolution: Unity and Diversity**

Students who demonstrate understanding can *analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.*

Clarifying Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.

Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze and interpret data to make sense of phenomena using logical reasoning.	Evidence of Common Ancestry and Diversity - Some kinds of plants and animals that once lived on Earth are no longer found anywhere. - Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.	Scale, Proportion, and Quantity - Observable phenomena exist from very short to very long time periods. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes consistent patterns in natural systems.

Pennsylvania Context: Examples of Pennsylvania's context include but are not limited to the state fossil, the trilobite (Phacops).

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.c: Evaluate geographic data and select necessary data sets to solve problems within AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.E. Organizing and analyzing information: Learners describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. K-4 Strand 1.G. Drawing conclusions and developing explanations: Learners develop explanations that address their questions about the environment.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.3.B: Ask and answer questions about the text and make inferences from text; refer to text to support responses. CC.1.2.3.A: Determine the main idea of a text; recount the key details and explain how they support the main idea. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.5.3.D: Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly with adequate volume, appropriate pacing, and clear pronunciation. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically. CC.2.4.3.A.4: Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs.
PA Standards: Social Studies	7.2.3.B: Identify the basic physical processes that affect the physical characteristics of places and regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grade 3**3.1.3.F Life Science: Biological Evolution: Unity and Diversity**

Students who demonstrate understanding can use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

Clarifying Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., observations, patterns) to construct an explanation.	Natural Selection Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: Examples of Pennsylvania context include the antler size of Pennsylvania’s white-tailed deer population.

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.G. Drawing conclusions and developing explanations: Learners develop explanations that address their questions about the environment. K-4 Strand 2.1.B. Earth’s living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.3.B: Ask and answer questions about the text and make inferences from text; refer to text to support responses. CC.1.2.3.A: Determine the main idea of a text; recount the key details and explain how they support the main idea. CC.1.4.3.A: Write informative/explanatory texts to examine a topic and convey ideas and information clearly. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.5.3.D: Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly with adequate volume, appropriate pacing, and clear pronunciation. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.3.A.4: Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs.
PA Standards: Social Studies	7.4.3.A: Identify the effect of the physical systems on people within a community.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-8G: Examine information to assess the trade-offs of using a product or system.

Grade 3**3.1.3.G Life Science:** Biological Evolution: Unity and Diversity

Students who demonstrate understanding can *construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.*

Clarifying Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct and/or support an argument with evidence, data, and/or a model.	Adaptation For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: Examples of Pennsylvania’s context include native and invasive species throughout different regions of Pennsylvania.

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.1.B. Earth’s living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.3.A: Determine the main idea of a text; recount the key details and explain how they support the main idea. CC.1.2.3.B: Ask and answer questions about the text and make inferences from text; refer to text to support responses. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.5.3.D: Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly with adequate volume, appropriate pacing, and clear pronunciation. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others. MP.4: Model with mathematics. CC.2.4.3.A.4: Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs.
PA Standards: Social Studies	7.4.3.A: Identify the effect of the physical systems on people within a community.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-1F: Describe the unique relationship between science and technology, and how the natural world can contribute to the human-made world to foster innovation.

Grade 3**3.1.3.H Life Science:** Biological Evolution: Unity and Diversity

Students who demonstrate understanding can *make a claim supported by evidence about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.*

Clarifying Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.

Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	Ecosystem Dynamics, Functioning, and Resilience - When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. Biodiversity and Humans - Populations live in a variety of habitats, and change in those habitats affects the organisms living there.	Systems and System Models - A system can be described in terms of its components and their interactions. Connections to Engineering, Technology, and Applications of Science Interdependence of Engineering, Technology, and Science on Society and the Natural World - Knowledge of relevant scientific concepts and research findings is important in engineering.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the impact of invasive species on Pennsylvania's environment, including spotted lanternflies, snakehead fish, phragmites, ailanthus trees (tree of heaven), ticks, crown vetch, and stink bugs.

PA Career Ready Skills: Identify possible behaviors and anticipate reactions in response to a specific social context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.a: Compare and contrast AFNR systems before and after the integration of technology.
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.3.C: Explain how a series of events, concepts, or steps in a procedure is connected within a text, using language that pertains to time, sequence, and cause/effect. CC.1.4.3.A: Write informative/explanatory texts to examine a topic and convey ideas and information clearly. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.5.3.D: Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly with adequate volume, appropriate pacing, and clear pronunciation.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.5: Use appropriate tools strategically. CC.2.4.3.A.4: Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs.
PA Standards: Social Studies	7.4.3.B: Identify the effect of people on the physical systems within a community.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-7M: Evaluate the strengths and weaknesses of existing design solutions, including their own solutions.

Grade 3**3.2.3.A Physical Science:** Motion and Stability: Forces and Interactions

Students who demonstrate understanding can *make and communicate observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.*

Clarifying Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.

Assessment Boundary: Assessment does not include technical terms such as period and frequency.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. - Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. Connections to Nature of Science Science Knowledge is Based on Empirical Evidence - Science findings are based on recognizing patterns.	Forces and Motion The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)	Patterns Patterns of change can be used to make predictions.

Pennsylvania Context: N/A

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR work-places or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.C. Collecting information: Learners locate and collect information about the environment and environmental topics.
PA Core Standards: ELA	CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.5: Use appropriate tools strategically. CC.2.4.3.A.1: Solve problems involving measurement and estimation of temperature, liquid volume, mass or length.
PA Standards: Social Studies	5.2.3.A: Identify personal rights and responsibilities. 8.1.3.A: Identify the difference between past, present and future using timelines and/or other graphic representations.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grade 3**3.2.3.B Physical Science:** Motion and Stability: Forces and Interactions

Students who demonstrate understanding can *plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.*

Clarifying Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.

Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. - Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. Connections to Nature of Science Scientific Investigations Use a Variety of Methods - Science investigations use a variety of methods, tools, and techniques.	Forces and Motion - Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) Types of Interactions - Objects in contact exert forces on each other.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: N/A

PA Career Ready Skills: Distinguish among and set short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.B. Designing investigations: Learners design simple environmental investigations.
PA Core Standards: ELA	CC.1.2.3.B: Ask and answer questions about the text and make inferences from text; refer to text to support responses. CC.1.2.3.C: Explain how a series of events, concepts, or steps in a procedure is connected within a text, using language that pertains to time, sequence, and cause/effect. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.2: Reason abstractly and quantitatively. CC.2.4.3.A.1: Solve problems involving measurement and estimation of temperature, liquid volume, mass or length.
PA Standards: Social Studies	5.2.3.A: Identify personal rights and responsibilities. 8.4.3.D: Identify conflict and cooperation among groups and organizations from around the world.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-2H: Identify the resources needed to get a technical job done, such as people, materials, capital, tools, machines, knowledge, energy, and time.

Grade 3**3.2.3.C Physical Science:** Motion and Stability: Forces and Interactions

Students who demonstrate understanding can ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

Clarifying Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paper clips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.

Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. Ask questions that can be investigated based on patterns such as cause and effect relationships.	Types of Interactions Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: N/A

PA Career Ready Skills: Respond to others given a sense of the others' point of view.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.A. Questioning: Learners develop questions that help them conduct simple investigations and learn about the environment.
PA Core Standards: ELA	CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.5: Use appropriate tools strategically. CC.2.4.3.A.1: Solve problems involving measurement and estimation of temperature, liquid volume, mass or length.
PA Standards: Social Studies	5.2.3.A: Identify personal rights and responsibilities. 7.4.3.A: Identify the effect of the physical systems on people within a community.
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grade 3**3.2.3.D Physical Science:** Motion and Stability: Forces and Interactions

Students who demonstrate understanding can *define a simple design problem that can be solved by applying scientific ideas about magnets.*

Clarifying Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. Define a simple problem that can be solved through the development of a new or improved object or tool.	Types of Interactions Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR work-places or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.3.A. Human-environment interactions: Learners identify ways that people depend on, change, and are affected by the environment.
PA Core Standards: ELA	N/A
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.5: Use appropriate tools strategically. CC.2.4.3.A.1: Solve problems involving measurement and estimation of temperature, liquid volume, mass or length.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-7I: Apply the technology and engineering design process.

Grade 3**3.3.3.A Earth and Space Sciences: Earth's Systems**

Students who demonstrate understanding can *represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.*

Clarifying Statement: Examples of data could include average temperature, precipitation, and wind direction.

Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.	Weather and Climate Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.	Patterns Patterns of change can be used to make predictions.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify different ways of expressing a feeling.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.E. Organizing and analyzing information: Learners describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. K-4 Strand 1.G. Drawing conclusions and developing explanations: Learners develop explanations that address their questions about the environment.
PA Core Standards: ELA	CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.7: Look for and make use of structure. CC.2.4.3.A.4: Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs.
PA Standards: Social Studies	8.1.3.A: Understand chronological thinking and distinguish between past, present and future time.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grade 3**3.3.3.B Earth and Space Sciences: Earth's Systems**

Students who demonstrate understanding can *obtain and combine information to describe climates in different regions of the world.*

Clarifying Statement: N/A

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Obtain and combine information from books and other reliable media to explain phenomena or solutions to a design problem.	Weather and Climate Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.	Patterns Patterns of change can be used to make predictions.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 2.1.A. Earth's physical systems: Learners describe characteristics of Earth's physical systems, including air, water, and land. They explain how these systems interact with one another and identify changes in the physical environment over time. They provide examples of how physical systems affect living organisms, including humans.
PA Core Standards: ELA	CC.1.2.3.B: Ask and answer questions about the text and make inferences from text; refer to text to support responses. CC.1.2.3.I: Compare and contrast the most important points and key details presented in two texts on the same topic. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.7: Look for and make use of structure. CC.2.4.3.A.1: Solve problems involving measurement and estimation of temperature, liquid volume, mass, and length.
PA Standards: Social Studies	8.1.3.B: Develop an understanding of historical sources. 7.2.3.A.: Identify the physical characteristics of places and regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-5D: Determine factors that influence changes in a society's technological systems or infrastructure.

Grade 3**3.3.3.C Earth and Space Sciences:** Earth and Human Activity

Students who demonstrate understanding can *make a claim supported by evidence about the merit of a design solution that reduces the impacts of a weather-related hazard.*

Clarifying Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	Natural Hazards A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.	Cause and Effect - Cause and effect relationships are routinely identified, tested, and used to explain change. Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World - Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). Connections to Nature of Science Science is a Human Endeavor - Science affects everyday life.

Pennsylvania Context: Examples of Pennsylvania context include weather-related hazards, including but not limited to flooding, tropical storms, hurricanes, winter storms, lake effects, and tornadoes that occur in Pennsylvania at varying frequencies.

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.c: Evaluate the importance of technology use and how it impacts AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.3.A. Human-environment interactions: Learners identify ways that people depend on, change, and are affected by the environment.
PA Core Standards: ELA	CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.5.3.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.3: Construct viable arguments and critique the reasoning of others. CC.2.4.3.A.2: Tell and write time to the nearest minute and solve problems by calculating time intervals.
PA Standards: Social Studies	7.4.3.A: Identify the effect of the physical systems on people within a community.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-7M: Evaluate the strengths and weaknesses of existing design solutions, including their own solutions.

Grade 4

3.1.4.A Life Science: From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Clarifying Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.

Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct and/or support an argument with evidence, data, and/or a model.	Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.	Systems and System Models A system can be described in terms of its components and their interactions.

Pennsylvania Context: N/A

PA Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.
PA Core Standards: ELA	CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly. CC.1.5.4.E: Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others. CC.2.3.4.A.3: Recognize symmetric shapes and draw lines of symmetry.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	6.1.4.D: Explain what influences the choices people make.
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-4J: Predict how certain aspects of their daily lives would be different without given technologies.

Grade 4**3.1.4.B Life Science: From Molecules to Organisms:** Structures and Processes

Students who demonstrate understanding can *use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.*

Clarifying Statement: Emphasis is on systems of information transfer.

Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Use a model to test interactions concerning the functioning of a natural system.	Information Processing Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.	Systems and System Models A system can be described in terms of its components and their interactions.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify different ways of expressing a feeling.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them. K-4 Strand 1.F. Working with models and simulations: Learners use models to represent environmental relationships, patterns, and processes.
PA Core Standards: ELA	CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly. CC.1.5.4.E: Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.3.4.A.3: Recognize symmetric shapes and draw lines of symmetry. CC.2.4.4.A.2: Translate information from one type of data display to another.
PA Standards: Social Studies	6.1.4.D: Explain what influences the choices people make.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-1F: Describe the unique relationship between science and technology, and how the natural world can contribute to the human-made world to foster innovation.

Grade 4**3.2.4.A Physical Science: Energy**

Students who demonstrate understanding can *use evidence to construct an explanation relating the speed of an object to the energy of that object.*

Clarifying Statement: N/A

Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., measurements, observations, patterns) to construct an explanation.	Definitions of Energy The faster a given object is moving, the more energy it possesses.	Energy and Matter Energy can be transferred in various ways and between objects.

Pennsylvania Context: N/A

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.G. Drawing conclusions and developing explanations: Learners develop explanations that address their questions about the environment.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.4.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade level reading standards for literature and informational texts. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	CC.2.2.4.A.1: Represent and solve problems involving the four operations. CC.2.4.4.A.2: Translate information from one type of data display to another.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grade 4**3.2.4.B Physical Science: Energy**

Students who demonstrate understanding can *make and communicate observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.*

Clarifying Statement: N/A

Assessment Boundary: Assessment does not include quantitative measurements of energy.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.	Definitions of Energy - Energy can be moved from place to place by moving objects or through sound, light, or electric currents. PS3.B: Conservation of Energy and Energy Transfer - Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. - Light also transfers energy from place to place. - Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.	Energy and Matter Energy can be transferred in various ways and between objects.

Pennsylvania Context: N/A

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.C. Collecting information: Learners locate and collect information about the environment and environmental topics.
PA Core Standards: ELA	CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.4.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade level reading standards for literature and informational texts.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others. CC.2.4.4.A.4: Represent and interpret data involving fractions using information provided in a line plot.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-7I: Apply the technology and engineering design process.

Grade 4**3.2.4.C Physical Science: Energy**

Students who demonstrate understanding can *ask questions and predict outcomes about the changes in energy that occur when objects collide.*

Clarifying Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.

Assessment Boundary: Assessment does not include quantitative measurements of energy.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.	Definitions of Energy - Energy can be moved from place to place by moving objects or through sound, light, or electric currents. Conservation of Energy and Energy Transfer - Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. Relationship Between Energy and Forces - When objects collide, the contact forces transfer energy so as to change the objects' motions.	Energy and Matter Energy can be transferred in various ways and between objects.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.A. Questioning: Learners develop questions that help them conduct simple investigations and learn about the environment.
PA Core Standards: ELA	CC.1.4.4.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade level reading standards for literature and informational texts. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. CC.2.4.4.A.2: Translate information from one type of data display to another.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-7I: Apply the technology and engineering design process.

Grade 4

3.2.4.D Physical Science: Energy

Students who demonstrate understanding can *apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*

Clarifying Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.

Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Apply scientific ideas to solve design problems.	Conservation of Energy and Energy Transfer - Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical. Energy in Chemical Processes and Everyday Life - The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. Defining Engineering Problems - Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	Energy and Matter - Energy can be transferred in various ways and between objects. Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World - Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones) Connections to Nature of Science Science is a Human Endeavor - Most scientists and engineers work in teams. - Science affects everyday life.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to wind farms, hydro energy, landfills, methane digesters, and solar farms.

PA Career Ready Skills: Distinguish among and set short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR work-places or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.B. Designing investigations: Learners design simple environmental investigations.
PA Core Standards: ELA	CC.1.4.4.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade level reading standards for literature and informational texts. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. CC.2.4.4.A.2: Translate information from one type of data display to another.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-7N: Practice successful design skills. STEL-7O: Apply tools, techniques, and materials in a safe manner as part of the design process.

Grade 4**3.2.4.E Physical Science:** Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can *develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.*

Clarifying Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.

Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. - Develop a model using an analogy, example, or abstract representation to describe a scientific principle. Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence - Science findings are based on recognizing patterns.	Wave Properties - Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. - Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).	Patterns Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.F. Working with models and simulations: Learners use models to represent environmental relationships, patterns, and processes.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.3.4.A.1: Draw lines and angles and identify these in two-dimensional figures. CC.2.4.4.A.2: Translate information from one type of data display to another.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2F: Describe how a subsystem is a system that operates as part of another, larger system.

Grade 4**3.2.4.F Physical Science:** Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can *develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.*

Clarifying Statement: N/A

Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Use and/or develop models to describe phenomena.	Electromagnetic Radiation An object can be seen when light reflected from its surface enters the eyes.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.F. Working with models and simulations: Learners use models to represent environmental relationships, patterns, and processes.
PA Core Standards: ELA	CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.3.4.A.1: Draw lines and angles and identify these in two-dimensional figures. CC.2.4.4.A.2: Translate information from one type of data display to another.
PA Standards: Social Studies	N/A

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2G: Illustrate how, when parts of a system are missing, it may not work as planned.

Grade 4**3.2.4.G Physical Science:** Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can generate and compare multiple solutions that use patterns to transfer information.

Clarifying Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	Information Technologies and Instrumentation - Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. Optimizing The Design Solution - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Patterns - Similarities and differences in patterns can be used to sort and classify designed products. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - Knowledge of relevant scientific concepts and research findings is important in engineering.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR work-places or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 3.1.C. Identifying and critiquing alternative solutions and courses of action: Learners develop plans, including possible design solutions, for addressing selected local environmental issues.
PA Core Standards: ELA	CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.4.4.A.4: Represent and interpret data involving fractions using information provided in a line plot.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-7M: Evaluate the strengths and weaknesses of existing design solutions, including their own solutions.

Grade 4**3.3.4.A Earth and Space Sciences:** Earth's Place in the Universe

Students who demonstrate understanding can *identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.*

Clarifying Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.

Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Identify the evidence that supports particular points in an explanation.	The History of Planet Earth Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.	Patterns - Patterns can be used as evidence to support an explanation. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes consistent patterns in natural systems.

Pennsylvania Context: Examples of Pennsylvania context include Pennsylvania rock cuts, caves, mine subsidence, and sinkholes.

PA Career Ready Skills: Distinguish among and set short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 2.1.A. Earth's physical systems: Learners describe characteristics of Earth's physical systems, including air, water, and land. They explain how these systems interact with one another and identify changes in the physical environment over time. They provide examples of how physical systems affect living organisms, including humans.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.2: Reason abstractly and quantitatively. CC.2.4.4.A.1: Solve problems involving measurement and conversions from a larger unit to a smaller unit. CC.2.4.4.A.4: Represent and interpret data involving fractions using information provided in a line plot.
PA Standards: Social Studies	7.2.4.A: Identify the physical characteristics of places and regions. 8.1.4.A: Identify and describe how geography and climate have influenced continuity and change over time.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4F: Describe the helpful and harmful effects of technology.

Grade 4**3.3.4.B Earth and Space Sciences: Earth's Systems**

Students who demonstrate understanding can *make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.*

Clarifying Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.

Assessment Boundary: Assessment is limited to a single form of weathering or erosion.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.	Earth Materials and Systems - Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. Biogeology - Living things affect the physical characteristics of their regions.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania Grand Canyon, local waterways, tombstones, glacier movement, potholes, soil erosion, the Pennsylvania state park system, and Pennsylvania's State Geologist.

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.c: Evaluate geographic data and select necessary data sets to solve problems within AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 1.C. Collecting information: Learners locate and collect information about the environment and environmental topics.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.4.A.1: Solve problems involving measurement and conversions from a larger unit to a smaller unit.
PA Standards: Social Studies	7.2.4.B: Identify the basic physical processes that affect the physical characteristics of places and regions. 8.1.4.A: Identify and describe how geography and climate have influenced continuity and change over time.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-2I: Describe the properties of different materials.

Grade 4**3.3.4.C Earth and Space Sciences: Earth's Systems**

Students who demonstrate understanding can *analyze and interpret data from maps to describe patterns of Earth's features.*

Clarifying Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze and interpret data to make sense of phenomena using logical reasoning.	Plate Tectonics and Large-Scale System Interactions The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.	Patterns Patterns can be used as evidence to support an explanation.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the Allegheny Plateau, Ridge and Valley, Atlantic Coastal Plain, piedmont, and watersheds.

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 2.1.A. Earth's physical systems: Learners describe characteristics of Earth's physical systems, including air, water, and land. They explain how these systems interact with one another and identify changes in the physical environment over time. They provide examples of how physical systems affect living organisms, including humans.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.2: Reason abstractly and quantitatively. CC.2.4.4.A.2: Translate information from one type of data display to another.
PA Standards: Social Studies	7.2.4.A: Identify the physical characteristics of places and regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grade 4**3.3.4.D Earth and Space Sciences:** Earth and Human Activity

Students who demonstrate understanding can *obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.*

Clarifying Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to mining, and air pollution from burning of fossil fuels.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	Cause and Effect - Cause and effect relationships are routinely identified and used to explain change. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - Knowledge of relevant scientific concepts and research findings is important in engineering. Influence of Engineering, Technology, and Science on Society and the Natural World - Over time, people's needs and wants change, as do their demands for new and improved technologies.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to wood, coal, methane, minerals, oil, gasses, wind farms, hydroelectric and nuclear power, and other geologic resources of Pennsylvania.

PA Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.02.01.b: Analyze natural resources trends and technologies and explain how they impact AFNR systems (e.g., climate change, green technologies, water resources, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.C. Collecting information: Learners locate and collect information about the environment and environmental topics. K-4 Strand 2.3.B. Resource distribution and consumption: Learners describe ways people harvest, re-distribute, and use natural resources.
PA Core Standards: ELA	CC.1.4.4.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade level reading standards for literature and informational texts. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.2: Reason abstractly and quantitatively. CC.2.2.4.A.1: Represent and solve problems involving the four operations. CC.2.4.4.A.2: Translate information from one type of data display to another.
PA Standards: Social Studies	7.4.4.B: Identify the effect of people on the physical systems within a community.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4F: Describe the helpful and harmful effects of technology.

Grade 4**3.3.4.E Earth and Space Sciences:** Earth and Human Activity

Students who demonstrate understanding can generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Clarifying Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.

Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	Natural Hazards - A variety of hazards result from natural processes. Humans cannot eliminate the hazards but can take steps to reduce their impacts. Designing Solutions to Engineering Problems - Testing a solution involves investigating how well it performs under a range of likely conditions.	Cause and Effect - Cause and effect relationships are routinely identified and used to explain change. Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World - Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones).

Pennsylvania Context: N/A

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR work-places or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 3.1.C. Identifying and critiquing alternative solutions and courses of action: Learners develop plans, including possible design solutions, for addressing selected local environmental issues.
PA Core Standards: ELA	CC.1.5.4.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.4.A.2: Translate information from one type of data display to another.
PA Standards: Social Studies	7.4.4.B: Identify the effect of people on the physical systems within a community.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-4G: Judge technologies to determine the best one to use to complete a given task or meet a need.

Grade 5

3.1.5.A Life Science: From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can *support an argument that plants get the materials they need for growth chiefly from air and water.*

Clarifying Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Support an argument with evidence, data, or a model.	Organization for Matter and Energy Flow in Organisms Plants acquire their material for growth chiefly from air and water.	Energy and Matter Matter is transported into, out of, and within systems.

Pennsylvania Context: Examples of Pennsylvania context include Pennsylvania's native plant species.

PA Career Ready Skills: Respond to others given a sense of the others' point of view.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners describe how living things, including humans, are dependent on their environment and are adapted to live in particular ecosystems under particular environmental conditions. They describe major interactions among organisms and populations of organisms and explain the importance of biodiversity to ecosystem health. They describe how humans affect and are affected by the biosphere.
PA Core Standards: ELA	CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.5: Use appropriate tools strategically. CC.2.4.5.A.2: Represent and interpret data using appropriate scale.
PA Standards: Social Studies	6.1.5: Explain how limited resources and unlimited wants cause scarcity.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-2F: Describe how a subsystem is a system that operates as part of another, larger system.

Grade 5**3.1.5.B Life Science: Ecosystems:** Interactions, Energy, and Dynamics

Students who demonstrate understanding can *develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.*

Clarifying Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.

Assessment Boundary: Assessment does not include molecular explanations.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions. - Use and/or develop models to describe phenomena. Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena - Science explanations describe the mechanisms for natural events.	Interdependent Relationships in Ecosystems - The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. Cycles of Matter and Energy Transfer in Ecosystems - Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment.	Systems and System Models A system can be described in terms of its components and their interactions.

Pennsylvania Context: Examples of Pennsylvania context include native plants and animals.

PA Career Ready Skills: Identify one’s own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models. 5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly. CC.1.5.5.E: Include multimedia components and visual displays in presentations when appropriate to enhance the development of main ideas or themes.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.5.A.2: Represent and interpret data using appropriate scale.
PA Standards: Social Studies	7.2.5.B: Identify the basic physical processes that affect the physical characteristics of places and regions.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2F: Describe how a subsystem is a system that operates as part of another, larger system.

Grade 5**3.2.5.A Physical Science:** Matter and Its Interactions

Students who demonstrate understanding can *develop a model to describe that matter is made of particles too small to be seen.*

Clarifying Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.

Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Use and/or develop models to describe phenomena.	Structure and Properties of Matter Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.	Scale, Proportion, and Quantity Natural objects exist from the very small to the immensely large.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.c: Teach others about the impact of foundational cycles within AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models. 5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.5.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade level reading standards for literature and informational texts. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.5: Use appropriate tools strategically. CC.2.4.5.A.1: Solve problems using conversions within a given measurement system. CC.2.4.5.A.6: Apply concepts of volume to solve problems and relate volume to multiplication and to addition.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2I: Describe the properties of different materials.

Grade 5**3.2.5.B Physical Science:** Matter and Its Interactions

Students who demonstrate understanding can *make and communicate observations and measurements to identify materials based on their properties.*

Clarifying Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.

Assessment Boundary: Assessment does not include density or distinguishing mass and weight.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.	Structure and Properties of Matter Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)	Scale, Proportion, and Quantity Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.C. Collecting information: Learners locate and collect quantitative and qualitative information about the environment and environmental topics, using a range of methods and sources. They explain why they used selected information collection methods.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.5.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade level reading standards for literature and informational texts. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.2: Reason abstractly and quantitatively. CC.2.1.5.B.1: Apply place value concepts to show an understanding of operations and rounding as they pertain to whole numbers and decimals. CC.2.4.5.A.6: Apply concepts of volume to solve problems and relate volume to multiplication and to addition.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-2I: Describe the properties of different materials.

Grade 5**3.2.5.C Physical Science:** Matter and Its Interactions

Students who demonstrate understanding can *interpret and analyze data to make decisions about how to utilize materials based on their properties.*

Clarifying Statement: N/A

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.	Structure and Properties of Matter Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)	Scale, Proportion, and Quantity Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR work-places or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.E. Organizing and analyzing information: Learners classify, organize, and display data and information they collect in ways that help them analyze and interpret their environmental investigations.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.5.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade level reading standards for literature and informational texts. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.5: Use appropriate tools strategically. CC.2.4.5.A.1: Solve problems using conversions within a given measurement system. CC.2.4.5.A.6: Apply concepts of volume to solve problems and relate volume to multiplication and to addition.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-2I: Describe the properties of different materials.

Grade 5**3.2.5.D Physical Science:** Matter and Its Interactions

Students who demonstrate understanding can *measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.*

Clarifying Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.

Assessment Boundary: Assessment does not include distinguishing mass and weight.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. Measure and graph quantities such as weight to address scientific and engineering questions and problems.	Structure and Properties of Matter - The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. Chemical Reactions - No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)	Scale, Proportion, and Quantity - Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes consistent patterns in natural systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.c: Teach others about the impact of foundational cycles within AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 1.C. Collecting information: Learners locate and collect quantitative and qualitative information about the environment and environmental topics, using a range of methods and sources. They explain why they used selected information collection methods.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.5.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade level reading standards for literature and informational texts. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.5.C.2: Apply and extend previous understandings of multiplication and division to multiply and divide fractions. CC.2.4.5.A.1: Solve problems using conversions within a given measurement system.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-2I: Describe the properties of different materials.

Grade 5**3.2.5.E Physical Science:** Matter and Its Interactions

Students who demonstrate understanding can *conduct an investigation to determine whether the mixing of two or more substances results in new substances.*

Clarifying Statement: N/A

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	Chemical Reactions When two or more different substances are mixed, a new substance with different properties may be formed.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: N/A

PA Career Ready Skills: Distinguish among and set short-term, mid-range, and long-term goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 1.B. Designing investigations: Learners design environmental investigations to answer specific questions—often their own questions.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.5.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade level reading standards for literature and informational texts. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.5.C.2: Apply and extend previous understandings of multiplication and division to multiply and divide fractions. CC.2.4.5.A.1: Solve problems using conversions within a given measurement system.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-2I: Describe the properties of different materials.

Grade 5**3.2.5.F Physical Science: Motion and Stability:** Forces and Interactions

Students who demonstrate understanding can *support an argument that the gravitational force exerted by Earth on objects is directed down.*

Clarifying Statement: “Down” is a local description of the direction that points toward the center of the spherical Earth.

Assessment Boundary: Assessment does not include mathematical representation of gravitational force.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Support an argument with evidence, data, or a model.	Types of Interactions The gravitational force of Earth acting on an object near Earth’s surface pulls that object toward the planet’s center.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: N/A

PA Career Ready Skills: Respond to others given a sense of the others’ point of view.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.G. Drawing conclusions and developing explanations: Learners synthesize their environmental observations and findings into coherent explanations.
PA Core Standards: ELA	CC.1.2.5.B: Cite textual evidence by quoting accurately from the text to explain what the text says explicitly and make inferences. CC.1.2.5.I: Integrate information from several texts on the same topic to demonstrate understanding of that topic. CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others’ ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-1F: Describe the unique relationship between science and technology, and how the natural world can contribute to the human-made world to foster innovation.

Grade 5**3.2.5.G Physical Science: Energy**

Students who demonstrate understanding can *use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.*

Clarifying Statement: Examples of models could include diagrams, and flow charts.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Use and/or develop models to describe phenomena.	Energy in Chemical Processes and Everyday Life - The energy released from food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). Organization for Matter and Energy Flow in Organisms - Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion.	Energy and Matter Energy can be transferred in various ways and between objects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to using Pennsylvania native species to demonstrate food chains and food webs.

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models. 5-8 Strand 2.1.B. Earth's living systems: Learners describe how living things, including humans, are dependent on their environment and are adapted to live in particular ecosystems under particular environmental conditions. They describe major interactions among organisms and populations of organisms and explain the importance of biodiversity to ecosystem health. They describe how humans affect and are affected by the biosphere.
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly. CC.1.5.5.E: Include multimedia components and visual displays in presentations when appropriate to enhance the development of main ideas or themes.
PA Core Standards and Practices: Math	CC.2.2.5.A.4: Analyze patterns and relationships using two rules.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grade 5**3.3.5.A Earth and Space Sciences:** Earth's Place in the Universe

Students who demonstrate understanding can *support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.*

Clarifying Statement: N/A

Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s) Support an argument with evidence, data, or a model.	The Universe and its Stars The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.	Scale, Proportion, and Quantity Natural objects exist from the very small to the immensely large.

Pennsylvania Context: N/A

PA Career Ready Skills: Respond to others given a sense of the others' point of view.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.G. Drawing conclusions and developing explanations: Learners synthesize their environmental observations and findings into coherent explanations.
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others. MP.4: Model with mathematics. CC.2.4.5.A.2: Represent and interpret data using appropriate scale.
PA Standards: Social Studies	7.1.5.A: Describe how common geographic tools are used to organize and interpret information about people, places, and environment.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grade 5**3.3.5.B Earth and Space Sciences:** Earth's Place in the Universe

Students who demonstrate understanding can *represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.*

Clarifying Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.

Assessment Boundary: Assessment does not include causes of seasons.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.	Earth and the Solar System The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.	Patterns Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 1.E. Organizing and analyzing information: Learners classify, organize, and display data and information they collect in ways that help them analyze and interpret their environmental investigations.
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.5.B.1: Apply place value concepts to show an understanding of operations and rounding as they pertain to whole numbers and decimals. CC.2.4.5.A.2: Represent and interpret data using appropriate scale.
PA Standards: Social Studies	7.1.5.A: Describe how common geographic tools are used to organize and interpret information about people, places, and environment.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grade 5**3.3.5.C Earth and Space Sciences: Earth's Systems**

Students who demonstrate understanding can *develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.*

Clarifying Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.

Assessment Boundary: Assessment is limited to the interactions of two systems at a time.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model using an analogy, example, or abstract representation to describe a scientific principle.	Earth Materials and Systems Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.	Systems and System Models A system can be described in terms of its components and their interactions.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models. 5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. CC.1.5.5.E: Include multimedia components and visual displays in presentations when appropriate to enhance the development of main ideas or themes.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.3.5.A.1: Graph points in the first quadrant on the coordinate plane and interpret these points when solving real world and mathematical problems. CC.2.4.5.A.2: Represent and interpret data using appropriate scale.
PA Standards: Social Studies	7.2.5.B: Identify the basic physical processes that affect the physical characteristics of places and regions.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2F: Describe how a subsystem is a system that operates as part of another, larger system.

Grade 5**3.3.5.D Earth and Space Sciences: Earth's Systems**

Students who demonstrate understanding can describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Clarifying Statement: N/A

Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. Describe and graph quantities such as area and volume to address scientific questions.	The Roles of Water in Earth's Surface Processes Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.	Scale, Proportion, and Quantity Standard units are used to measure and describe physical quantities such as weight and volume.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's water reservoirs and aquifers.

PA Career Ready Skills: Respond to others given a sense of the others' point of view.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. CC.1.5.5.E: Include multimedia components and visual displays in presentations when appropriate to enhance the development of main ideas or themes. CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.6: Attend to precision. CC.2.4.5.A.2: Represent and interpret data using appropriate scale.
PA Standards: Social Studies	7.2.5.A: Describe the characteristics of places and regions.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3A: Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.

Grade 5**3.3.5.E Earth and Space Sciences:** Earth and Human Activity

Students who demonstrate understanding can *obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.*

Clarifying Statement: N/A

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	Human Impacts on Earth Systems Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	Systems and System Models - A system can be described in terms of its components and their interactions. Connections to Nature of Science Science Addresses Questions About the Natural and Material World. - Science findings are limited to questions that can be answered with empirical evidence.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to quarries, reclamation of mines, riparian buffer zones, stream bank fencing, forest and land management, Pennsylvania Conservation Districts, extension services, Pennsylvania Fish and Boat Commission, Pennsylvania Fish and Game Commission, and Pennsylvania Department of Agriculture.

PA Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.3.A. Human-environment interactions: Learners describe human-caused changes that affect the immediate environment as well as other places, other people, and future times.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.5.5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.6: Attend to precision. CC.2.4.5.A.2: Represent and interpret data using appropriate scale.
PA Standards: Social Studies	7.4.5.B: Identify the effect of people on the physical systems within a community.
Educational Technology (ISTE)	1.7. Global Collaborator: Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.
Technology and Engineering (ITEEA)	STEL-4I: Explain why responsible use of technology requires sustainable management of resources.

Grade 5**3.3.5.F Earth and Space Sciences:** Earth and Human Activity

Students who demonstrate understanding can generate and design possible solutions to a current environmental issue, threat, or concern.

Clarifying Statement: This could include but is not limited to topics such as biodiversity, watersheds, invasive species, natural resources, etc.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. - Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. - Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. - Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).	Cycles of Matter and Energy Transfer in Ecosystems Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment.	Connections to Nature of Science Science Addresses Questions About the Natural and Material World. Science findings are limited to questions that can be answered with empirical evidence.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to acid mine drainage, fracking, water quality, invasive species such as the spotted lanternfly and zebra mussel, and threatened or endangered species such as the eastern hellbender.

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 3.2.C. Planning and taking action: Learners use their research results to develop action strategies and design solutions at levels consistent with their maturity and preparation. As appropriate, they implement their plans.
PA Core Standards: ELA	CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.5.A.2: Represent and interpret data using appropriate scale.
PA Standards: Social Studies	7.4.5.B: Identify the effect of people on the physical systems within a community.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-7H: Illustrate that there are multiple approaches to design. STEL-7I: Apply the technology and engineering design process.

Grades 3–5

3.4.3-5.A Environmental Literacy and Sustainability: Agriculture and Environmental Systems and Resources

Students who demonstrate understanding can analyze how living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Clarifying Statement: Emphasis is on how plants and animals impact their environment and how their environment impacts them. Examples include how pollinators impact food, plants prevent erosion, and sidewalks/roads change water flow.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze and interpret data to make sense of phenomena using logical reasoning.	Human Impacts on Earth Systems Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	Cause and Effect - Cause and effect relationships are routinely identified and used to explain change. Structure and Function - Different materials have different substructures, which can sometimes be observed. Substructures have shapes and parts that serve functions.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's natural environment, waterways, watersheds, natural ecosystems, and changes (natural and human-caused).

PA Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.2.3.D: Explain the point of view of the author. CC.1.2.4.D: Compare and contrast an event or topic told from two different points of view. CC.1.2.5.D: Analyze multiple accounts of the same event or topic, noting important similarities and differences in the point of view they represent. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. CC.1.5.3-5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.A.4: Represent and interpret data involving fractions using information provided in a line plot.
PA Standards: Social Studies	7.4.3.B: Identify the effect of people on the physical systems within a community.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4F: Describe the helpful and harmful effects of technology.

Grades 3–5**3.4.3-5.B Environmental Literacy and Sustainability:** Agriculture and Environmental Systems and Resources

Students who demonstrate understanding can *make a claim about the environmental and social impacts of design solutions and civic actions, including their own actions.*

Clarifying Statement: Emphasis is on investigating the short- and long-term consequences or effects of design solutions (i.e., best management practices such as manure management plans, riparian buffers, and wildlife corridors).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	Human Impacts on Earth Systems - Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. Natural Resources - Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	Cause and Effect Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania land use practices such as urbanization, sprawl, transportation, heat, agriculture, waste, energy, recreation, and mining.

PA Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.02.01.c: Defend or challenge natural resources trends and technologies based upon an assessment of their impact on AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 3.2.D. Evaluating the results of actions: Learners identify environmental, social, and economic consequences of design solutions and civic actions, including their own actions.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.3.U: With guidance and support, use technology to produce and publish writing (using keyboarding skills) as well as to interact and collaborate with others. CC.1.4.4-5.U: With some guidance and support, use technology, including the internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of one page in a single sitting. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. CC.1.5.3.B: Determine the main ideas and supporting details of a text read aloud or information presented in diverse media formats, including visually, quantitatively, and orally. CC.1.5.4.B: Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. CC.1.5.5.B: Summarize the main points of written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. CC.1.5.3-5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.3.A.4: Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs. CC.2.4.4.A.4: Represent and interpret data involving fractions using information provided in a line plot.
PA Standards: Social Studies	5.2.3.A: Identify personal rights and responsibilities.
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-4F: Describe the helpful and harmful effects of technology.

Grades 3–5**3.4.3-5.C Environmental Literacy and Sustainability:** Sustainability and Stewardship

Students who demonstrate understanding can *examine ways you influence your local environment and community by collecting and displaying data.*

Clarifying Statement: Emphasis is on analyzing individual student behavior. Data can be collected and displayed using multiple digital and analog tools (e.g., computers, calculators, timers) and formats (e.g., graphs, tables, charts).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. - Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts. Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. - Use evidence (e.g., observations, patterns) to support an explanation.	Natural Resources - Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. Human Impacts on Earth Systems - Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 1.E. Organizing and analyzing information: Learners describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.
PA Core Standards: ELA	CC.1.4.3.U: With guidance and support, use technology to produce and publish writing (using keyboarding skills) as well as to interact and collaborate with others. CC.1.4.4-5.U: With some guidance and support, use technology, including the internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of one page in a single sitting. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.5: Use appropriate tools strategically. CC.2.4.3.A.4: Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs. CC.2.4.4.A.4: Represent and interpret data involving fractions using information provided in a line plot.
PA Standards: Social Studies	7.4.3.B: Identify the effect of people on the physical systems within a community.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3D: Explain how various relationships can exist between technology and engineering and other content areas.

Grades 3–5**3.4.3-5.D Environmental Literacy and Sustainability:** Environmental Literacy

Students who demonstrate understanding can *develop a model to demonstrate how local environmental issues are connected to larger local environment and human systems.*

Clarifying Statement: Examples include watersheds, food webs, human food systems, and life cycles. Emphasis is on investigating local environments and understanding how they connect to larger regional, national, and global systems.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Use and/or develop models to describe phenomena.	Human Impacts on Earth Systems - Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. Biodiversity and Humans - Populations live in a variety of habitats, and change in those habitats affects the organisms living there.	Systems and System Models - A system can be described in terms of its components and their interactions. Cause and Effect - Cause and effect relationships are routinely identified and used to explain change.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's natural environment, waterways, watersheds, natural ecosystems and changes (natural and human-caused), and natural disasters such as flooding, tornadoes, hurricanes, fires, and droughts.

PA Career Ready Skills: Identify possible behaviors and anticipate reactions in response to a specific social context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.02.02.b: Analyze the connections and relationships impacted when there is a change in an AFNR system on a national and global level.
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 3.1.B. Sorting out the consequences of issues: Learners use their knowledge of how ecological and human systems are interconnected to describe the environmental, social, and economic consequences of local environmental issues.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.4.3.U: With guidance and support, use technology to produce and publish writing (using keyboarding skills) as well as to interact and collaborate with others. CC.1.4.4-5.U: With some guidance and support, use technology, including the internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of one page in a single sitting. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.3.A.4: Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs. CC.2.4.4.A.4: Represent and interpret data involving fractions using information provided in a line plot.
PA Standards: Social Studies	7.2.3.B: Identify the basic physical processes that affect the physical characteristics of places and regions.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2F: Describe how a subsystem is a system that operates as part of another, larger system.

Grades 3–5**3.4.3-5.E Environmental Literacy and Sustainability:** Sustainability and Stewardship

Students who demonstrate understanding can *construct an argument to support whether action is needed on a selected environmental issue and propose possible solutions.*

Clarifying Statement: Using the claim-evidence-reasoning model or other critical thinking processes, students analyze and synthesize data they have personally collected or compiled from provided sources to support their claims and proposed stewardship actions.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). - Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. - Obtain and combine information from books and/or other reliable media to explain solutions to a design problem.	Biodiversity and Humans - Populations live in a variety of habitats, and change in those habitats affects the organisms living there. Human Impacts on Earth Systems - Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	Cause and Effect - Cause and effect relationships are routinely identified and used to explain change. Patterns - Patterns of change can be used to make predictions.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania-specific laws, policies, regulations, and agreements such as the Pennsylvania Environmental Plan, Pennsylvania's Environmental Rights Amendment, and the Chesapeake Bay Agreement.

PA Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.02.02.c: Design and implement strategies for implementing a new natural resources policy that will positively impact AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	K-4 Strand 3.2.B. Evaluating the need for action: Learners determine whether action is needed on selected environmental issues and whether they should be involved. They describe their reasoning.
PA Core Standards: ELA	CC.1.2.3.B: Ask and answer questions about the text and make inferences from text; refer to text to support responses. CC.1.2.4.B: Refer to details and examples in text to support what the text says explicitly and make inferences. CC.1.2.5.B: Cite textual evidence by quoting accurately from the text to explain what the text says explicitly and make inferences. CC.1.5.3-5.A: Engage effectively in a range of collaborative discussions on grade-level topics and texts, building on others' ideas and expressing their own clearly.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.4.A.4: Represent and interpret data involving fractions using information.
PA Standards: Social Studies	5.2.3.A: Identify personal rights and responsibilities. 5.2.5.D: Identify specific ways individuals participate in school and community activities. 5.3.5.G: Describe how groups try to influence others.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-1I: Explain how solutions to problems are shaped by economic, political, and cultural forces.

Grades 3–5**3.4.3-5.F Environmental Literacy and Sustainability:** Sustainability and Stewardship

Students who demonstrate understanding can *critique ways that people depend on and change the environment.*

Clarifying Statement: This could include both positive and negative ways that people depend on and impact the environment. Examples include but are not limited to water, fuel, food, land, and recreation.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. - Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). - Construct and/or support an argument with evidence, data, and/or a model.	Natural Resources - Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. Human Impacts on Earth Systems - Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	Cause and Effect - Cause and effect relationships are routinely identified and used to explain change. Stability and Change - Change is measured in terms of differences over time and may occur at different rates.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania land use practices such as urbanization, sprawl, transportation, heat, agriculture, waste, energy, recreation, and mining.

PA Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.b: Analyze available practices to steward natural resources in AFNR systems (e.g., wildlife and land conservation, soil and water practices, ecosystem management, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	K-4 Strand 2.3.A. Human-environment interactions: Learners identify ways that people depend on, change, and are affected by the environment.
PA Core Standards: ELA	CC.1.2.3.B: Ask and answer questions about the text and make inferences from text; refer to text to support responses. CC.1.2.4.B: Refer to details and examples in text to support what the text says explicitly and make inferences. CC.1.2.5.B: Cite textual evidence by quoting accurately from the text to explain what the text says explicitly and make inferences. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically. CC.2.4.4.A.4: Represent and interpret data involving fractions using information provided in a line plot.
PA Standards: Social Studies	7.4.3.B: Identify the effect of people on the physical systems within a community.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-4I: Explain why responsible use of technology requires sustainable management of resources.

Grades 3–5**3.4.3-5.G Environmental Literacy and Sustainability:** Environmental Literacy Skills

Students who demonstrate understanding can *investigate how perspectives over the use of resources and the development of technology have changed over time and resulted in conflict over the development of societies and nations.*

Clarifying Statement: Emphasis is on diverse points of view that may change over time due to new information, developing technology, priorities, or competition for finite resources.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. - Analyze and interpret data to make sense of phenomena using logical reasoning. Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. - Obtain and combine information from books and other reliable media to explain phenomena. Using Mathematics and Computational Thinking Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. - Organize simple data sets to reveal patterns that suggest relationships.	Natural Resources - Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. Human Impacts on Earth Systems - Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	Cause and Effect - Cause and effect relationships are routinely identified and used to explain change. Stability and Change - Change is measured in terms of differences over time and may occur at different rates.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania Environmental Justice Area designations or Environmental Health Indicators.

PA Career Ready Skills: Select coping skill strategies response to adverse situations (e.g., positive self-talk, talking to others, taking a break, taking care of oneself, avoiding negative self-talk).

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.a: Compare and contrast AFNR systems before and after the integration of technology.
Science, Environmental Literacy and Sustainability (NAEEE)	K-4 Strand 2.3.D. Change and conflict: Learners recognize that change is a normal part of individual and societal life. They describe examples of ways that conflict related to the environment or natural resources may be rooted in different points of view.
PA Core Standards: ELA	CC.1.5.3.B: Determine the main ideas and supporting details of a text read aloud or information presented in diverse media formats, including visually, quantitatively, and orally. CC.1.5.4.B: Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. CC.1.5.5.B: Summarize the main points of written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. CC.1.5.3.D: Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details; speak clearly with adequate volume, appropriate pacing, and clear pronunciation. CC.1.5.4.D: Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly with adequate volume, appropriate pacing, and clear pronunciation. CC.1.5.5.D: Report on a topic or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly with adequate volume, appropriate pacing, and clear pronunciation.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.4.A.4: Represent and interpret data involving fractions using information provided in a line plot.
PA Standards: Social Studies	5.2.3.B: Identify the sources of conflict and disagreement and different ways conflict can be resolved.
Educational Technology (ISTE)	1.7. Global Collaborator: Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.
Technology and Engineering (ITEEA)	STEL-5E: Explain how technologies are developed or adapted when individual or societal needs and wants change.

Grades 3–5**3.5.3-5.A Technology and Engineering:** Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can *use appropriate symbols, numbers and words to communicate key ideas about technological products and systems.*

Clarifying Statement: Most of these symbols are found in everyday life, such as the alphabet, numbers, punctuation marks, or commercial logos. There are technical symbols to be aware of as well, including hazardous material symbols, caution signs, and the recycling logo.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	Developing Possible Solutions At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	Communication Develops written and oral communication skills.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.B Technology and Engineering:** Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can *examine information to assess the trade-offs of using a product or system.*

Clarifying Statement: To assess technologies, information such as cost, function, durability, and warranties could be collected on products such as toys, food, games, health products, school supplies, and clothes to assess the costs, benefits, and trade-offs of these products or systems.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze data to refine a problem statement or the design of a proposed object, tool, or process.	Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	Systems Thinking - Provides examples of how human-designed products are connected. Attention to Ethics - Explains ethical dilemmas involving technology, such as tradeoffs.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.C Technology and Engineering:** Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can *follow directions to complete a technological task.*

Clarifying Statement: Skill development typically starts with guided instruction, and many tasks require following a specific sequence of steps.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	Developing Possible Solutions - Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. - At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	Making and Doing Safely uses grade-appropriate tools, materials, and processes to build projects.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.D Technology and Engineering:** Impacts of Technology

Students who demonstrate understanding can *predict how certain aspects of their daily lives would be different without given technologies.*

Clarifying Statement: Historical examples of daily life before modern technologies such as airplanes, computers, modern agriculture, sanitation, and so on will give students opportunities to consider how their lives have been impacted by technology.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.	Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	Critical Thinking Knows how to find answers to technological questions.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's food production industries.

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	3.3.3.C: Make a claim supported by evidence about the merit of a design solution that reduces the impacts of a weather-related hazard.

Grades 3–5**3.5.3-5.E Technology and Engineering:** Impacts of Technology

Students who demonstrate understanding can *explain why responsible use of technology requires sustainable management of resources.*

Clarifying Statement: Building on their initial understandings about material resources, students can tie concepts of renewability, scarcity, and resource demand to sustainable use, defined as availability of a resource for use by future generations.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	Human Impacts on Earth Systems Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	Critical Thinking Knows how to find answers to technological questions.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	3.3.5.F: Generate and design possible solutions to a current environmental issue, threat, or concern.

Grades 3–5**3.5.3-5.F Technology and Engineering:** Impacts of Technology

Students who demonstrate understanding can *classify resources used to create technologies as either renewable or nonrenewable.*

Clarifying Statement: An introduction to material resources and how they are recovered will help students understand the concept of renewability and its importance and can be tied to concepts they learn in science.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	Critical Thinking Knows how to find answers to technological questions.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.G Technology and Engineering:** Impacts of Technology

Students who demonstrate understanding can *describe the helpful and harmful effects of technology.*

Clarifying Statement: Students can begin to explore more fully the idea of intended, unintended, positive, and negative outcomes inherent in technologies. Students at this age learn how their own lives have been impacted through technology and how technological processes generate undesirable waste and emissions.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct and/or support an argument with evidence, data, and/or a model.	N/A	Attention to Ethics Explains ethical dilemmas including technology, such as tradeoffs.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	3.3.4.E: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Grades 3–5**3.5.3-5.H Technology and Engineering:** Influence of Society on Technological Development

Students who demonstrate understanding can *determine factors that influence changes in a society's technological systems or infrastructure.*

Clarifying Statement: Individual, family, and community values as well as environmental and economic factors may expand or limit the development of technologies. Students should recognize that products and systems are designed and marketed for a variety of purposes, including to generate profit. Sometimes these changes come at the expense of human and environmental health.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.	Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	Systems Thinking Provides examples of how human-designed products are connected.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's food production industries.

Pennsylvania Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5

3.5.3-5.1 Technology and Engineering: Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *design solutions by safely using tools, materials, and skills.*

Clarifying Statement: People use appropriate tools and skills to help them do their work (e.g., a carpenter uses a hammer to build a house; a doctor uses diagnostic imaging machines to treat patients). People also use resources, such as metal, wood, cloth, and stone, to make things they use every day.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	Defining and Delimiting Engineering Problems - Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. Developing Possible Solutions - Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. - At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. - Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.	Making and Doing Safely uses grade-appropriate tools, materials, and processes to build projects.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.J Technology and Engineering:** Influence of Society on Technological Development

Students who demonstrate understanding can *explain how technologies are developed or adapted when individual or societal needs and wants change.*

Clarifying Statement: More useful and efficient technologies are developed when society identifies a need. When something changes in the environment, technologies are developed in response to the new conditions. For example, if a local water source runs dry, solutions must be designed for alternative water purification and transport. Engineers improve existing technologies by designing and creating to meet new constraints and requirements.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Optimism Engages in “tinkering” to improve a design.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania’s food production industries.

Pennsylvania Career Ready Skills: Identify one’s own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	3.3.5.E: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Grades 3–5**3.5.3-5.K Technology and Engineering:** Impacts of Technology

Students who demonstrate understanding can *judge technologies to determine the best one to use to complete a given task or meet a need.*

Clarifying Statement: Through exposure to the function and use of various age-appropriate tools/ technologies, students can determine which tools are best for a given task and can explain their selection.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.	Developing Possible Solutions Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.	Critical Thinking Knows how to find answers to technological questions.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Identify different ways of expressing a feeling.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.L Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *demonstrate how tools and machines extend human capabilities, such as holding, lifting, carrying, fastening, separating, and computing.*

Clarifying Statement: The use of tools and machines, such as glue guns, mini-saws, rulers, scissors, gears, clamps, and computers, makes it possible for people to accomplish more tasks.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct and/or support an argument with evidence, data, and/or a model.	Developing Possible Solutions Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.	Optimism Engages in “tinkering” to improve a design.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.M Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *demonstrate essential skills of the engineering design process.*

Clarifying Statement: Young children identify that there are some essential skills, such as creative thinking, building, and testing, that are required to succeed in technology and engineering design.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	Defining and Delimiting Engineering Problems - Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. Developing Possible Solutions - Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. - At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. - Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Optimizing the Design Solution - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Creativity - Tries new technologies and generates strategies for improving existing ideas. Making and Doing - Safely uses grade-appropriate tools, materials, and processes to build projects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.N Technology and Engineering:** Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can *identify why a product or system is not working properly.*

Clarifying Statement: Technological systems and products do not last forever. For elementary students this can be unsettling when they expect everything to work every time. A chain coming off a bike gear becomes a teachable moment on how things function and how to get them working again. This concept is important for all students to learn. Teachers can ask questions to identify why the technology is not working properly, what could be a logical explanation of the problem, and what might be the easiest solution to address the problem.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Developing Possible Solutions At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	Optimism - Engages in “tinkering” to improve a design. Critical Thinking - Knows how to find answers to technological questions.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.O Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *describe requirements of designing or making a product or system.*

Clarifying Statement: Requirements are the criteria or expected outcomes we use when designing. For example, it is often impossible to make a product in a certain way because of the cost of materials or because of time constraints, such as needing the product to be made more quickly than is possible with the method in question. These limits are considered in making decisions about designing and making a product.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	Defining and Delimiting Engineering Problems - Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. Developing Possible Solutions - Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. - Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Optimizing the Design Solution - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Communication Develops written and oral communication skills.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.P Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *evaluate the strengths and weaknesses of existing design solutions, including their own solutions.*

Clarifying Statement: Students can evaluate a range of potential solutions by analyzing their relative strengths and weaknesses. Using criteria and constraints, students acknowledge the limitations caused by one solution and continue to explore a range of ideas.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.	Developing Possible Solutions - Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Optimizing the Design Solution - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Critical Thinking - Knows how to find answers to technological questions. Optimism - Engages in “tinkering” to improve a design.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify multiple ways to solve conflicts and practice solving problems.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.Q Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can practice successful design skills.

Clarifying Statement: Continued opportunities to experience and develop essential design skills will improve students' design experiences. Students engage in developmentally appropriate experiences to develop these essential skills, which will often be teacher-driven.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Defining and Delimiting Engineering Problems - Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. Developing Possible Solutions - Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. - At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. - Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Optimizing the Design Solution - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Creativity Tries new technologies and generates strategies for improving existing ideas.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.R Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *apply tools, techniques, and materials in a safe manner as part of the design process.*

Clarifying Statement: Students understand that designers practice the making skills necessary to successfully complete a design. Continued opportunities to explore tools, techniques, and materials will result in refining the skills necessary to successfully design. Students can begin to select appropriate tools and materials for an identified purpose.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	Making and Doing Safely uses grade-appropriate tools, materials, and processes to build projects.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.S Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *illustrate that there are multiple approaches to design.*

Clarifying Statement: Design approaches are determined by the context, the individual, the available resources, and the intended purpose of the design.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.	ETS1.C: Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Creativity - Tries new technologies and generates strategies for improving existing ideas. Attention to Ethics - Explains ethical dilemmas involving technology, such as tradeoffs.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Respond to others given a sense of the others' point of view.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5
3.5.3-5.T Technology and Engineering: Design in Technology and Engineering Education

Students who demonstrate understanding can *apply universal principles and elements of design.*

Clarifying Statement: Students develop the necessary vocabulary to identify, describe, and begin to apply the principles and elements of design. Students can appreciate the impact of these principles and elements on design quality.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Defining and Delimiting Engineering Problems - Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. Developing Possible Solutions - Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. - At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. - Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Optimizing the Design Solution - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Making and Doing Safely uses grade-appropriate tools, materials, and processes to build projects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.U Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *evaluate designs based on criteria, constraints, and standards.*

Clarifying Statement: Students in this grade band develop an appropriate vocabulary to identify and discuss design parameters or requirements. They can recognize that purposeful design decisions are based on criteria and constraints.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.	Developing Possible Solutions Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.	Critical Thinking Knows how to find answers to technological questions.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Select coping skill strategies response to adverse situations (e.g., positive self-talk, talking to others, taking a break, taking care of oneself, avoiding negative self-talk).

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.V Technology and Engineering:** Design in Technology and Engineering Education

Students who demonstrate understanding can *interpret how good design improves the human condition.*

Clarifying Statement: Students expand their scope of understanding by identifying wants and needs associated with the human condition beyond their immediate surroundings. Students recognize the potential impacts of design on the quality of life.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Optimism Engages in “tinkering” to improve a design.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify one’s own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.W Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *describe the properties of different materials.*

Clarifying Statement: Students should understand the difference between natural and human-made materials and their basic properties. For example, wood, stone, metal, glass, and concrete are hard and dense; leather, paper, and some metals are flexible; glass and some plastics are transparent. Some materials conduct heat and electricity while others insulate to stop or delay transmission of heat or electricity. The properties of a specific material determine whether it is suitable for a given application.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.	Structure and Properties of Matter Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.	Communication Develops written and oral communication skills.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Respond to others given a sense of the others' point of view.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.X Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *explain how various relationships can exist between technology and engineering and other content areas.*

Clarifying Statement: Students can learn how to convert energy from the wind to power a motor or from acidic fruits such as oranges and grapefruits to energize an LED light. This type of project uses information from mathematics, science, and other fields to develop a deeper understanding among students about technology and engineering products and systems.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	N/A	Collaboration Works in small groups to complete design-based projects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Explain ways to establish relationships that are positive and supportive of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	3.2.4.C: Ask questions and predict outcomes about the changes in energy that occur when objects collide.

Grades 3–5**3.5.3-5.Y Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *identify the resources needed to get a technical job done, such as people, materials, capital, tools, machines, knowledge, energy, and time.*

Clarifying Statement: Elementary students involved in problem-solving activities such as Odyssey of the Mind need to develop a list of resources that they will need for a play they must perform in front of judges. Strategic planning of resources might include the backdrop, costumes, props, what roles the team members will play, and a consideration of deadlines.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	Critical Thinking Knows how to find answers to technological questions.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5

3.5.3-5.Z Technology and Engineering: Core Concepts of Technology and Engineering

Students who demonstrate understanding can *create a new product that improves someone's life.*

Clarifying Statement: Inventions are created to fulfill a human need or want. Inventions are the way that humans attempt to improve upon the natural world. Identifying various products that have helped people with disabilities, such as ITEEA's "Dream Ride GoBabyGo Style" initiative, is a good starting point for helping students find needs and consider innovative ways of meeting those needs.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Defining and Delimiting Engineering Problems - Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. Developing Possible Solutions - Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. - At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. - Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Optimizing the Design Solution - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Creativity - Tries new technologies and generates strategies for improving existing ideas. Making and Doing - Safely uses grade-appropriate tools, materials, and processes to build projects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Explain ways to establish relationships that are positive and supportive of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.AA Technology and Engineering: History of Technology**

Students who demonstrate understanding can *create representations of the tools people made, how they cultivated to provide food, made clothing, and built shelters to protect themselves.*

Clarifying Statement: Historical technological products and systems did not always work and often many attempts and variations were tested before an idea became a reality. For example, the development of pottery stretched over 10,000 years. People learned to mix various clays to make stronger items and they learned to fire pottery in ovens to harden the clay more quickly. Various containers, such as jugs, vases, and cups were designed and developed for holding things such as water, milk, seeds, and grains. Not all of the designs worked, and variations may be seen in every ancient civilization. Representations developed in the classroom could include sketches, dioramas, models, photographic slide shows, and so on.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	Defining & Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	Making and Doing Safely uses grade-appropriate tools, materials, and processes to build projects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.BB Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *illustrate how, when parts of a system are missing, it may not work as planned.*

Clarifying Statement: A computer does not work when the power fails or when the battery has been removed.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).	Developing Possible Solutions Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.	Systems Thinking Provides examples of how human-designed products are connected.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Identify consequences of a decision to oneself and others prior to action.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3-5**3.5.3-5.CC Technology and Engineering:** Core Concepts of Technology and Engineering

Students who demonstrate understanding can *describe how a subsystem is a system that operates as a part of another larger system.*

Clarifying Statement: An example of a subsystem is the assemblage of water pipes in a house, which is part of a larger fresh-water distribution system in a town, city, or community.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	Developing Possible Solutions Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.	Systems Thinking Provides examples of how human-designed products are connected.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Select and utilize expressive communication strategies (e.g., tone, body language, facial expressions) with an understanding of its effect on others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.DD Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *demonstrate how simple technologies are often combined to form more complex systems.*

Clarifying Statement: Students could construct a small robot to demonstrate simple circuits using wires, a motor, and a power source (battery). Another example would be how an escalator uses the wheel and axle, inclined plane, pulley, gears, belts, and an electric motor to move people from one level to another.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.	Optimizing The Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Systems Thinking Provides examples of how human-designed products are connected.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Explain ways to establish relationships that are positive and supportive of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	3.3.5.F: Generate and design possible solutions to a current environmental issue, threat, or concern.

Grades 3–5**3.5.3-5.EE Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *explain how solutions to problems are shaped by economic, political, and cultural forces.*

Clarifying Statement: For example, the interests, desires, and financial resources of a group of people will influence the type of transportation system developed for that community. A transportation system for a large city may rely on mass transit, while one in a smaller town might rely on personal vehicles.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	N/A	Systems Thinking Provides examples of how human-designed products are connected.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania Department of Labor and Industry regulations.

Pennsylvania Career Ready Skills: Identify one's own strengths, needs, and preferences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	3.3.5.F: Generate and design possible solutions to a current environmental issue, threat, or concern.

Grades 3–5**3.5.3-5.FF Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *compare how things found in nature differ from things that are human-made, noting differences and similarities in how they are produced and used.*

Clarifying Statement: For example, the essentials for natural plant growth are sunshine (photosynthesis), air, water, and nutrients; whereas human-made items require an idea, resources (e.g., time, money, materials, and machines), and techniques. Things found in nature, such as trees, birds, and wildflowers, require no human intervention. On the other hand, creating human-made products, such as shoes, requires human effort and innovation.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	Engineering Design Engineering design is a systematic and creative process for meeting challenges. Often there are several solutions to a design challenge. Each one might be better in some way than the others. For example, one solution might be safer, while another might cost less.	Systems Thinking Provides examples of how human-designed products are connected.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local examples of Pennsylvania food production, agriculture, urban agriculture, and aquaculture.

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices Select and use appropriate digital and network tools and media resources to collect, organize, analyze, and display supporting data to answer questions and test hypotheses.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.7: Look for and make use of structure.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 3–5**3.5.3-5.GG Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *describe the unique relationship between science and technology, and how the natural world can contribute to the human-made world to foster innovation.*

Clarifying Statement: People have, from the beginning, looked around to identify and use the materials and resources available to improve their lives. Raw materials and resources are shaped into tools, systems, and forms of energy to provide people with products that satisfy a need or want. Energy is harnessed to provide power and heat, and animals and crops are raised for food and clothing. These and other processes continue today as people use raw materials to create items they want and need.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	N/A	Creativity Tries new technologies and generates strategies for improving existing ideas.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Explain ways to establish relationships that are positive and supportive of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	3.3.3.C: Make a claim supported by evidence about the merit of a design solution that reduces the impacts of a weather-related hazard.

Grades 3–5**3.5.3-5.HH Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *differentiate between the role of scientists, engineers, technologists, and others in creating and maintaining technological systems.*

Clarifying Statement: The roles of scientists, engineers, and technologists are interrelated, yet each contributes a unique area of expertise to every endeavor. Students should be able to identify how individuals with different areas of content knowledge inform the creation of technology, and why this collaboration is important.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.	N/A	Communication Develops written and oral communication skills.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Demonstrate respect for the uniqueness of others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. MP.5: Use appropriate tools strategically.
Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic Standards	N/A

Grades 6–8

3.1.6-8.A Life Science: Structure, Function, and Information Processing

Students who demonstrate understanding can conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

Clarifying Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.	Structure and Function All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).	Scale, Proportion, and Quantity - Phenomena that can be observed at one scale may not be observable at another scale. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Interact with others demonstrating respect, cooperation, and acceptance.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.C. Collecting information: Learners locate and collect quantitative and qualitative information about the environment and environmental topics, using a range of methods and sources. They explain why they used selected information collection methods.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
PA Core Standards and Practices: Math	CC.2.2.6.B.3: Represent and analyze quantitative relationships between dependent and independent variables. CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.1: Draw inferences about populations based on random sampling concepts. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.B Life Science:** Structure, Function, and Information Processing

Students who demonstrate understanding can *develop and use a model to describe the function of a cell as a whole and the ways the parts of cells contribute to the function.*

Clarifying Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.

Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	Structure and Function Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.	Structure and Function Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models.
PA Core Standards: ELA	CC.1.5.8.E: Adapt speech to a variety of contexts and tasks.
PA Core Standards and Practices: Math	CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models. CC.2.4.7.B.1: Draw inferences about populations based on random sampling concepts.
PA Standards: Social Studies	N/A

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2N: Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Grades 6–8**3.1.6-8.C Life Science:** Structure, Function, and Information Processing

Students who demonstrate understanding can *use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.*

Clarifying Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.

Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	Structure and Function In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.	Systems and System Models - Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. Connections to Nature of Science Science is a Human Endeavor - Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain how expressive communication strategies can affect others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.A: Write arguments focused on discipline-specific content. CC.1.4.7.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade-level reading standards for literature and literary nonfiction.
PA Core Standards and Practices: Math	CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-2N: Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Grades 6–8**3.1.6-8.D Life Science:** Growth, Development, and Reproduction of Organisms

Students who demonstrate understanding can use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.

Clarifying Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	Growth and Development of Organisms - Animals engage in characteristic behaviors that increase the odds of reproduction. - Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.	Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Pennsylvania Context: Examples of Pennsylvania context include different regions of Pennsylvania that have local native species.

PA Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.1.4.7.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade-level reading standards for literature and literary nonfiction. CC.3.6.6-8.A: Write arguments focused on discipline-specific content.
PA Core Standards and Practices: Math	CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models. CC.2.4.7.B.1: Draw inferences about populations based on random sampling concepts. CC.2.4.8.B.1: Analyze and/or interpret bivariate data displayed in multiple representations. CC.2.4.8.B.2: Understand that patterns of association can be seen in bivariate data utilizing frequencies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.E Life Science:** Growth, Development, and Reproduction of Organisms

Students who demonstrate understanding can *construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.*

Clarifying Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.

Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Growth and Development of Organisms Genetic factors as well as local conditions affect the growth of the adult plant.	Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Pennsylvania Context: N/A

PA Career Ready Skills: Distinguish among various social contexts and how they impact personal feelings.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them. 5-8 Strand 3.1.B. Sorting out the consequences of issues: Learners apply their knowledge of ecological and human processes and systems to describe the short- and long-term consequences of selected environmental issues on sustainability.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.B: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. CC.3.6.6-8.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research.
PA Core Standards and Practices: Math	CC.2.4.6.B.1: Apply and extend previous understandings of arithmetic to algebraic expressions. CC.2.4.6.B.2: Understand the process of solving a one-variable equation or inequality and apply it to real-world and mathematical problems. CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions.
PA Standards: Social Studies	7.4.7.A: Describe and explain the effects of the physical systems on people within regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.F Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.*

Clarifying Statement: Emphasis is on tracing movement of matter and flow of energy.

Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. - Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Connections to Nature of Science Scientific Knowledge Is Based on Empirical Evidence - Science knowledge is based upon logical connections between evidence and explanations.	Organization for Matter and Energy Flow in Organisms - Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. Energy in Chemical Processes and Everyday Life - The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen.	Energy and Matter Within a natural system, the transfer of energy drives the motion and/or cycling of matter.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.B: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. CC.3.6.6-8.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research.
PA Core Standards and Practices: Math	CC.2.2.6.B.3: Represent and analyze quantitative relationships between dependent and independent variables. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models. CC.2.4.7.B.1: Draw inferences about populations based on random sampling concepts.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-2M: Differentiate between inputs, processes, outputs, and feedback in technological systems.

Grades 6–8**3.1.6-8.G Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.*

Clarifying Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.

Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms.	Organization for Matter and Energy Flow in Organisms - Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. Energy in Chemical Processes and Everyday Life - Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.	Energy and Matter Matter is conserved because atoms are conserved in physical and chemical processes.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.5.8.E: Adapt speech to a variety of contexts and tasks.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	6.1.6.B: Compare ways that people meet their needs with how they meet their wants. Describe how resources are combined to produce different goods and services.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.H Life Science:** Structure, Function, and Information Processing

Students who demonstrate understanding can *gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.*

Clarifying Statement: N/A

Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.	Information Processing Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.C. Collecting information: Learners locate and collect quantitative and qualitative information about the environment and environmental topics, using a range of methods and sources. They explain why they used selected information collection methods.
PA Core Standards: ELA	CC.3.6.6-8.G: Gather relevant information from multiple print and digital resources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of other while avoiding plagiarism and following a standard format for citation.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.I Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.*

Clarifying Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to provide evidence for phenomena.	Interdependent Relationships in Ecosystems - Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. - In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. - Growth of organisms and population increases are limited by access to resources.	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the Pennsylvania deer population.

PA Career Ready Skills: Make a decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.02.a: Read and interpret the definition of sustainability and summarize how it relates to AFNR activities.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.3.B. Resource distribution and consumption: Learners explain that uneven geographic distribution of natural resources influences their use and perceived value. 5-8 Strand 3.1.B. Sorting out the consequences of issues: Learners apply their knowledge of ecological and human processes and systems to describe the short- and long-term consequences of selected environmental issues on sustainability.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	CC.2.4.8.B.1: Analyze and/or interpret bivariate data displayed in multiple representations. CC.2.4.8.B.2: Understand that patterns of association can be seen in bivariate data utilizing frequencies.
PA Standards: Social Studies	6.1.6.A: Explain how limited resources and unlimited wants cause scarcity. 7.4.7.A: Describe and explain the effects of the physical systems on people within regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4L: Analyze how the creation and use of technologies consumes renewable and nonrenewable resources and creates waste.

Grades 6–8**3.1.6-8.J Life Science:** Interdependent Relationships in Ecosystems

Students who demonstrate understanding can *construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.*

Clarifying Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.	Interdependent Relationships in Ecosystems Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.	Patterns Patterns can be used to identify cause and effect relationships.

Pennsylvania Context: N/A

PA Career Ready Skills: Distinguish among various social contexts and how they impact personal feelings.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research. CC.1.5.8.A: Engage effectively in a range of collaborative discussions, on grade-level topics, texts, and issues, building on others' ideas and expressing their own clearly. CC.1.5.8.D: Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound, valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume and clear pronunciation.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.K Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.*

Clarifying Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.

Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	Cycle of Matter and Energy Transfer in Ecosystems Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.	Energy and Matter - The transfer of energy can be tracked as energy flows through a natural system. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.5.8.E: Adapt speech to a variety of contexts and tasks.
PA Core Standards and Practices: Math	CC.2.4.8.B.1: Analyze and/or interpret bivariate data displayed in multiple representations. CC.2.4.8.B.2: Understand that patterns of association can be seen in bivariate data utilizing frequencies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-4L: Devise strategies for reducing, reusing, and recycling waste caused from the creation and use of technology.

Grades 6–8**3.1.6-8.L Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.*

Clarifying Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). - Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence - Science disciplines share common rules of obtaining and evaluating empirical evidence.	Ecosystem Dynamics, Functioning, and Resilience Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.	Stability and Change Small changes in one part of a system might cause large changes in another part.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania’s invasive species, such as the spotted lanternfly.

PA Career Ready Skills: Make a decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.3.A. Human-environment interactions: Learners describe human-caused changes that affect the immediate environment as well as other places, other people, and future times. 5-8 Strand 3.1.B. Sorting out the consequences of issues: Learners apply their knowledge of ecological and human processes and systems to describe the short- and long-term consequences of selected environmental issues on sustainability.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.1.4.9-10.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade-level reading standards for literature and literary nonfiction. CC.3.6.6-8.A: Write arguments focused on discipline-specific content.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	7.4.7.A: Describe and explain the effects of the physical systems on people within regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8

3.1.6-8.M Life Science: Growth, Development, and Reproduction of Organisms

Students who demonstrate understanding can *develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.*

Clarifying Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.

Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	Inheritance of Traits - Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. Variation of Traits - In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism.	Structure and Function Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them. 5-8 Strand 2.3.B. Resource distribution and consumption: Learners explain that uneven geographic distribution of natural resources influences their use and perceived value.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.D: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). CC.1.5.8.E: Adapt speech to a variety of contexts and tasks.
PA Core Standards and Practices: Math	CC.2.2.7.B.3: Model and solve real-world and mathematical problems by using and connecting numerical, algebraic, and/or graphical representations.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.N Life Science:** Growth, Development, and Reproduction of Organisms

Students who demonstrate understanding can *develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.*

Clarifying Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	Growth and Development of Organisms - Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. Inheritance of Traits - Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. Variation of Traits - In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain how empathy and perspective taking foster relationship building.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.D: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). CC.1.5.8.E: Adapt speech to a variety of contexts and tasks.
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.O Life Science:** Natural Selection and Adaptations

Students who demonstrate understanding can *analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.*

Clarifying Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.

Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. - Analyze and interpret data to determine similarities and differences in findings. Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence - Science knowledge is based upon logical and conceptual connections between evidence and explanations.	Evidence of Common Ancestry and Diversity The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.	Patterns - Graphs, charts, and images can be used to identify patterns in data. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

Pennsylvania Context: Examples of Pennsylvania context include Pennsylvania's local fossil evidence.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.1: Draw inferences about populations based on random sampling concepts. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models.
PA Standards: Social Studies	7.1.7.A: Explain how common geographic tools are used to organize and interpret information about people, places, and environment.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.P Life Science:** Natural Selection and Adaptations

Students who demonstrate understanding can *apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.*

Clarifying Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events.	Evidence of Common Ancestry and Diversity Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.	Patterns - Patterns can be used to identify cause and effect relationships. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

Pennsylvania Context: Examples of Pennsylvania context include Pennsylvania’s local fossil evidence.

PA Career Ready Skills: Explain how empathy and perspective taking foster relationship building.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research. CC.1.5.8.A: Engage effectively in a range of collaborative discussions, on grade-level topics, texts, and issues, building on others' ideas and expressing their own clearly. CC.1.5.8.D: Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound, valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume and clear pronunciation.
PA Core Standards and Practices: Math	CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.1: Draw inferences about populations based on random sampling concepts.
PA Standards: Social Studies	7.2.7.A: Explain the characteristics of places and regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.Q Life Science:** Natural Selection and Adaptations

Students who demonstrate understanding can *analyze displays of pictorial data to compare patterns of similarities in anatomical structures across multiple species to identify relationships not evident in the fully formed anatomy.*

Clarifying Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.

Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze displays of data to identify linear and nonlinear relationships.	Evidence of Common Ancestry and Diversity Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.	Patterns Graphs, charts, and images can be used to identify patterns in data.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.E. Organizing and analyzing information: Learners classify, organize, and display data and information they collect in ways that help them analyze and interpret their environmental investigations.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). CC.3.5.6-8.I: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	7.2.7.A: Explain the characteristics of places and regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.R Life Science:** Growth, Development, and Reproduction of Organisms

Students who demonstrate understanding can *gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.*

Clarifying Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.	Natural Selection In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring.	Cause and Effect - Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. Connections to Nature of Science Science Addresses Questions About the Natural and Material World - Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's biotechnology and agriculture industries.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them. 5-8 Strand 2.3.A. Human-environment interactions: Learners describe human-caused changes that affect the immediate environment as well as other places, other people, and future times.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.G: Gather relevant information from multiple print and digital resources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of other while avoiding plagiarism and following a standard format for citation.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	6.1.6.B: Compare ways that people meet their needs with how they meet their wants. Describe how resources are combined to produce different goods and services.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-6C: Compare various technologies and how they have contributed to human progress.

Grades 6–8**3.1.6-8.S Life Science:** Natural Selection and Evolution

Students who demonstrate understanding can *construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.*

Clarifying Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.	Natural Selection Natural selection leads to the predominance of certain traits in a population, and the suppression of others.	Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to genetic variations in local Pennsylvania species such as albino squirrels, black squirrels, albino deer, Pennsylvania elk, timber rattlesnakes, river otters, or brown trout.

PA Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.I: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. CC.3.6.6-8.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research. CC.1.5.8.A: Engage effectively in a range of collaborative discussions, on grade-level topics, texts, and issues, building on others' ideas and expressing their own clearly. CC.1.5.8.D: Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound, valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume and clear pronunciation.
PA Core Standards and Practices: Math	CC.2.1.7.D.1: Analyze proportional relationships and use them to model and solve real-world and mathematical problems.
PA Standards: Social Studies	7.4.6.A: Describe and explain the effects of the physical systems on people within regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.1.6-8.T Life Science:** Natural Selection and Evolution

Students who demonstrate understanding can use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

Clarifying Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.

Assessment Boundary: Assessment does not include Hardy Weinberg calculations.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. Use mathematical representations to support scientific conclusions and design solutions.	Adaptation Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.	Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to genetic variations in local Pennsylvania species such as albino squirrels, black squirrels, albino deer, Pennsylvania elk, timber rattlesnakes, river otters, or brown trout.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.
PA Core Standards: ELA	N/A

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.1.7.D.1: Analyze proportional relationships and use them to model and solve real-world and mathematical problems. CC.2.4.7.B.1: Draw inferences about populations based on random sampling concepts. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models.
PA Standards: Social Studies	7.4.6.A: Describe and explain the effects of the physical systems on people within regions.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8

3.1.6-8.U Life Science: Interdependent Relationships in Ecosystems

Students who demonstrate understanding can evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Clarifying Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	Ecosystem Dynamics, Functioning, and Resilience - Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. Biodiversity and Humans - Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. Developing Possible Solutions - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	Stability and Change - Small changes in one part of a system might cause large changes in another part. Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World - The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. Connections to Nature of Science Science Addresses Questions About the Natural and Material World - Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's agriculture industry and invasive species.

PA Career Ready Skills: Make a decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 3.1.C. Identifying and critiquing alternative solutions and courses of action: Learners identify and develop action strategies, including design solutions, appropriate for addressing a range of environmental issues at community and regional levels. They describe how their action strategies and design solutions might impact environmental quality and other people now and in the future.
PA Core Standards: ELA	CC.3.5.6-8.H: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. CC.1.4.9-10.S: Draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade-level reading standards for literature and literary nonfiction.
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.1.6.D.1: Understand ratio concepts and use ratio reasoning to solve problems.
PA Standards: Social Studies	7.4.7.B: Describe and explain the effects of people on the physical systems within regions.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-4K: Examine the ways that technology can have both positive and negative effects at the same time. STEL-7U: Evaluate the strengths and weaknesses of different design solutions.

Grades 6–8**3.2.6-8.A Physical Science:** Structure and Properties of Matter

Students who demonstrate understanding can *develop models to describe the atomic composition of simple molecules and extended structures.*

Clarifying Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.

Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	Structure and Properties of Matter - Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. - Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).	Scale, Proportion, and Quantity Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.6.D.1: Understand ratio concepts and use ratio reasoning to solve problems. CC.2.2.8.B.1: Apply concepts of radicals and integer exponents to generate equivalent expressions.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2N: Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Grades 6–8**3.2.6-8.B Physical Science:** Structure and Properties of Matter

Students who demonstrate understanding can *develop a model that predicts and describes changes in particle motion, temperature and state of a pure substance when thermal energy is added or removed.*

Clarifying Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	Structure and Properties of Matter - Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. - In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. - The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. Definitions of Energy - The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. - The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system’s total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Pennsylvania Context: Examples of Pennsylvania context include that Pennsylvania’s bodies of water have different water levels in different seasons.

PA Career Ready Skills: Make decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models. 5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	CC.2.1.6.E.4: Apply and extend previous understandings of numbers to the system of rational numbers.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-1K: Compare and contrast the contributions of science, engineering, mathematics, and technology in the development of technological systems.

Grades 6–8**3.2.6-8.C Physical Science:** Structure and Properties of Matter

Students who demonstrate understanding can *gather and make sense of information to describe that synthetic materials come from natural resources and impact society.*

Clarifying Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.

Assessment Boundary: Assessment is limited to qualitative information.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence.	Structure and Properties of Matter - Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. Chemical Reactions - Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	Structure and Function - Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. Influence of Science, Engineering and Technology on Society and the Natural World - The uses of technologies and any limitation on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.

Pennsylvania Context: Examples of Pennsylvania context include that Pennsylvania's natural resources are manufactured into synthetic materials.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.a: Define stewardship of natural resources and distinguish how it connects to AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.G: Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	6.1.6.A: Explain how limited resources and unlimited wants cause scarcity. 7.4.7.A: Describe and explain the effects of the physical systems on people within regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-6C: Compare various technologies and how they have contributed to human progress.

Grades 6–8**3.2.6-8.D Physical Science:** Chemical Reactions

Students who demonstrate understanding can *analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.*

Clarifying Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.

Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. - Analyze and interpret data to determine similarities and differences in findings. Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence - Science knowledge is based upon logical and conceptual connections between evidence and explanations.	Structure and Properties of Matter - Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. Chemical Reactions - Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	Patterns Macroscopic patterns are related to the nature of microscopic and atomic-level structure.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems. 5-8 Strand 1.E. Organizing and analyzing information: Learners classify, organize, and display data and information they collect in ways that help them analyze and interpret their environmental investigations.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models. CC.2.4.8.B.1: Analyze and/or interpret bivariate data displayed in multiple representations. CC.2.4.8.B.2: Understand that patterns of association can be seen in bivariate data utilizing frequencies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-1K: Compare and contrast the contributions of science, engineering, mathematics, and technology in the development of technological systems.

Grades 6–8**3.2.6-8.E Physical Science: Chemical Reactions**

Students who demonstrate understanding can *develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.*

Clarifying Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.

Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. - Develop a model to describe unobservable mechanisms. Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena - Laws are regularities or mathematical descriptions of natural phenomena.	Chemical Reactions - Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. - The total number of each type of atom is conserved, and thus the mass does not change.	Energy and Matter Matter is conserved because atoms are conserved in physical and chemical processes.

Pennsylvania Context: N/A

PA Career Ready Skills: Interact with others demonstrating respect, cooperation, and acceptance.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.6.D.1: Understand ratio concepts and use ratio reasoning to solve problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-1K: Compare and contrast the contributions of science, engineering, mathematics, and technology in the development of technological systems.

Grades 6–8**3.2.6-8.F Physical Science:** Chemical Reactions

Students who demonstrate understanding can *undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*

Clarifying Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.

Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.	Chemical Reactions - Some chemical reactions release energy, others store energy. Developing Possible Solutions - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Optimizing the Design Solution - Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. - The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	Energy and Matter The transfer of energy can be tracked as energy flows through a designed or natural system.

Pennsylvania Context: N/A

PA Career Ready Skills: Make a decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR workplaces or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 3.1.C. Identifying alternative solutions and courses of action: Learners identify and develop action strategies, including design solutions, appropriate for addressing a range of environmental issues at community and regional levels. They describe how their action strategies and design solutions might impact environmental quality and other people now and in the future.
PA Core Standards: ELA	CC.3.5.6-8.C: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-2M: Differentiate between inputs, processes, outputs, and feedback in technological systems. STEL-7Q: Apply the technology and engineering design process.

Grades 6–8**3.2.6-8.G Physical Science:** Forces and Interactions

Students who demonstrate understanding can *apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*

Clarifying Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.

Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas or principles to design an object, tool, process or system.	PS2.A: Forces and Motion For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).	Systems and System Models - Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World - The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify and evaluate distractors that impact reaching one's goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR workplaces or scenarios using technology.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 3.2.C. Planning and taking action: Learners use their research results to develop action strategies and design solutions at levels consistent with their maturity and preparation. As appropriate, they implement their plans.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.C: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.6.E.4: Apply and extend previous understandings of numbers to the system of rational numbers. CC.2.2.6.B.1: Apply and extend previous understandings of arithmetic to algebraic expressions.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-1R: Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system. STEL-7Q: Apply the technology and engineering design process.

Grades 6–8**3.2.6-8.H Physical Science:** Forces and Interactions

Students who demonstrate understanding can plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

Clarifying Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.

Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.	PS2.A: Forces and Motion - The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. - All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.	Stability and Change Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.
Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence Science knowledge is based upon logical and conceptual connections between evidence and explanations.		

Pennsylvania Context: N/A

PA Career Ready Skills: Identify and evaluate distractors that impact reaching one's goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAAEE)	5.8 Strand 1.B. Designing investigations: Learners design environmental investigations to answer specific questions—often their own questions.
PA Core Standards: ELA	CC.3.5.6-8.C: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.2.7.B.3: Model and solve real-world and mathematical problems by using and connecting numerical, algebraic, and/or graphical representations.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-1L: Explain how technology and engineering are closely linked to creativity, which can result in both intended and unintended innovations.

Grades 6–8**3.2.6-8.1 Physical Science:** Forces and Interactions

Students who demonstrate understanding can *ask questions about data to determine the factors that affect the strength of electric and magnetic forces.*

Clarifying Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.

Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Asking Questions and Defining Problems Asking questions and defining problems in 6–8 builds from K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.	Types of Interactions Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-8M: Use instruments to gather data on the performance of everyday products.

Grades 6–8**3.2.6-8.J Physical Science:** Forces and Interactions

Students who demonstrate understanding can *construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.*

Clarifying Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.

Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. - Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence - Science knowledge is based upon logical and conceptual connections between evidence and explanations.	Types of Interactions Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.	Systems and System Models Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy and matter flows within systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.G. Drawing conclusions and developing explanations: Learners synthesize their environmental observations and findings into coherent explanations.
PA Core Standards: ELA	CC.3.6.6-8.A: Cite specific textual evidence to support analysis of science and technical texts.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.2.6-8.K Physical Science:** Forces and Interactions

Students who demonstrate understanding can *conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.*

Clarifying Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.

Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.	Types of Interactions Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR workplaces or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 1.C. Collecting information: Learners locate and collect quantitative and qualitative information about the environment and environmental topics, using a range of methods and sources. They explain why they used selected information collection methods.
PA Core Standards: ELA	CC.3.5.6-8.C: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-1K: Compare and contrast the contributions of science, engineering, mathematics, and technology in the development of technological systems.

Grades 6–8**3.2.6-8.L Physical Science: Energy**

Students who demonstrate understanding can *construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass and to the speed of an object.*

Clarifying Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings.	Definitions of Energy Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.	Scale, Proportion, and Quantity Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's amusement or theme parks.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.6.D.1: Understand ratio concepts and use ratio reasoning to solve problems. CC.2.1.7.D.1: Analyze proportional relationships and use them to model and solve real-world and mathematical problems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-2N: Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Grades 6–8**3.2.6-8.M Physical Science: Energy**

Students who demonstrate understanding can *apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*

Clarifying Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.

Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.	Definitions of Energy - Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. Conservation of Energy and Energy Transfer - Energy is spontaneously transferred out of hotter regions or objects and into colder ones. Defining and Delimiting an Engineering Problem - The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. ETS1.B: Developing Possible Solutions - A solution needs to be tested, and then modified on the basis of the test results in order to improve it. - There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem.	Energy and Matter The transfer of energy can be tracked as energy flows through a natural system.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify and evaluate distractors that impact reaching one's goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR workplaces or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.C: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-7Q: Apply the technology and engineering design process. STEL-7U: Evaluate the strengths and weaknesses of different design solutions.

Grades 6–8**3.2.6-8.N Physical Science: Energy**

Students who demonstrate understanding can plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Clarifying Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.

Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. - Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence - Science knowledge is based upon logical and conceptual connections between evidence and explanations	Definitions of Energy - Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. Conservation of Energy and Energy Transfer - The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.	Scale, Proportion, and Quantity Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's major cities as urban heat islands.

PA Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.C: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-2N: Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Grades 6–8**3.2.6-8.O Physical Science: Energy**

Students who demonstrate understanding can *construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.*

Clarifying Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.

Assessment Boundary: Assessment does not include calculations of energy.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. - Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence - Science knowledge is based upon logical and conceptual connections between evidence and explanations	Conservation of Energy and Energy Transfer When the motion energy of an object changes, there is inevitably some other change in energy at the same time.	Energy and Matter Energy may take different forms (e.g., energy in fields, thermal energy, energy of motion).

Pennsylvania Context: N/A

PA Career Ready Skills: Explain how expressive communication strategies can affect others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.A: Write arguments focused on discipline-specific content.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.6.D.1: Understand ratio concepts and use ratio reasoning to solve problems. CC.2.1.7.D.1: Analyze proportional relationships and use them to model and solve real-world and mathematical problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2M: Differentiate between inputs, processes, outputs, and feedback in technological systems.

Grades 6–8**3.2.6-8.P Physical Science: Energy**

Students who demonstrate understanding can *develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.*

Clarifying Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.

Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms.	Definitions of Energy - A system of objects may also contain stored (potential) energy, depending on their relative positions. Relationship Between Energy and Forces - When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.	Systems and System Models Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's amusement or theme parks.

PA Career Ready Skills: Make a decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2N: Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Grades 6–8**3.2.6-8.Q Physical Science:** Waves and Electromagnetic Radiation

Students who demonstrate understanding can *use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.*

Clarifying Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.

Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. - Use mathematical representations to describe and/or support scientific conclusions and design solutions. Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence - Science knowledge is based upon logical and conceptual connections between evidence and explanations.	Wave Properties A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.	Patterns Graphs and charts can be used to identify patterns in data.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models.
PA Core Standards: ELA	CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.8.B.1: Analyze and/or interpret bivariate data displayed in multiple representations. CC.2.4.8.B.2: Understand that patterns of association can be seen in bivariate data utilizing frequencies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-1K: Compare and contrast the contributions of science, engineering, mathematics, and technology in the development of technological systems.

Grades 6–8**3.2.6-8.R Physical Science:** Waves and Electromagnetic Radiation

Students who demonstrate understanding can *develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.*

Clarifying Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.

Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	Wave Properties - A sound wave needs a medium through which it is transmitted. Electromagnetic Radiation - When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves.	Structure and Function Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models.
PA Core Standards: ELA	CC.1.5.8.E: Adapt speech to a variety of contexts and tasks.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.2.6-8.S Physical Science:** Waves and Electromagnetic Radiation

Students who demonstrate understanding can *integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.*

Clarifying Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.

Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods. Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings.	Information Technologies and Instrumentation Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	Structure and Function - Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. Connections to Nature of Science Science is a Human Endeavor - Advances in technology influence the progress of science and science has influenced advances in technology. Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World - Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.G. Drawing conclusions and developing explanations: Learners synthesize their environmental observations and findings into coherent explanations.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.B: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. CC.3.5.6-8.I: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4N: Analyze examples of technologies that have changed the way people think, interact, and communicate.

Grades 6–8**3.3.6-8.A Earth and Space Science: Space Systems**

Students who demonstrate understanding can *develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.*

Clarifying Statement: Examples of models can be physical, graphical, or conceptual.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	The Universe and Its Stars - Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. Earth and the Solar System - This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.	Patterns - Patterns can be used to identify cause-and-effect relationships. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.1.5.8.E: Adapt speech to a variety of contexts and tasks.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.1.6.D.1: Understand ratio concepts and use ratio reasoning to solve problems. CC.2.1.7.D.1: Analyze proportional relationships and use them to model and solve real-world and mathematical problems.
PA Standards: Social Studies	7.1.6.A: Describe how common geographic tools are used to organize and interpret information about people, places, and environment.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.3.6-8.B Earth and Space Science: Space Systems**

Students who demonstrate understanding can *develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.*

Clarifying Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).

Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	The Universe and Its Stars - Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. Earth and the Solar System - The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. - The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.	Systems and System Models - Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.b: Analyze and interpret AFNR related geographic data using a variety of systems and technologies (e.g., GIS, GPS, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.1.5.8.E: Adapt speech to a variety of contexts and tasks.
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.2.7.B.3: Model and solve real-world and mathematical problems by using and connecting numerical, algebraic, and/or graphical representations.
PA Standards: Social Studies	7.1.6.A: Describe how common geographic tools are used to organize and interpret information about people, places, and environment.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.3.6-8.C Earth and Space Science: Space Systems**

Students who demonstrate understanding can *analyze and interpret data to determine scale properties of objects in the solar system.*

Clarifying Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.

Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings.	Earth and the Solar System The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.	Scale, Proportion, and Quantity - Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.b: Analyze and interpret AFNR related geographic data using a variety of systems and technologies (e.g., GIS, GPS, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 1.E. Organizing and analyzing information: Learners classify, organize, and display data and information they collect in ways that help them analyze and interpret their environmental investigations.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models.
PA Standards: Social Studies	7.1.6.A: Describe how common geographic tools are used to organize and interpret information about people, places, and environment.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.3.6-8.D Earth and Space Science: History of Earth**

Students who demonstrate understanding can *construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.*

Clarifying Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.

Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	The History of Planet Earth The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.	Scale, Proportion, and Quantity Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's cave systems, mines, quarries, local road cuts, and building sites.

PA Career Ready Skills: Explain how expressive communication strategies can affect others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	CC.2.2.7.B.3: Model and solve real-world and mathematical problems by using and connecting numerical, algebraic, and/or graphical representations.
PA Standards: Social Studies	7.2.6.B: Describe the physical processes that shape patterns on Earth's surface.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8

3.3.6-8.E Earth and Space Science: History of Earth

Students who demonstrate understanding can *construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.*

Clarifying Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future.	Earth's Materials and Systems - The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. The Roles of Water in Earth's Surface Processes - Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.	Scale, Proportion, and Quantity Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Pennsylvania Context: Examples of Pennsylvania context include local Pennsylvania topography resulting from glacial impacts, plate collisions, and erosion.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.2.6.B.2: Understand the process of solving a one-variable equation or inequality and apply it to real-world and mathematical problems.
PA Standards: Social Studies	7.2.6.B: Describe the physical processes that shape patterns on Earth's surface.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.3.6-8.F Earth and Space Science: Earth's Systems**

Students who demonstrate understanding can *develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.*

Clarifying Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.

Assessment Boundary: Assessment does not include the identification and naming of minerals.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	Earth's Materials and Systems All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.	Stability and Change Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the formation of limestone and coal, such as bituminous, as compared to anthracite and limestone, as compared to marble in Pennsylvania.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.1.5.8.E: Adapt speech to a variety of contexts and tasks.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	7.4.6.B: Describe and explain the effects of people on the physical systems within regions.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-4L: Analyze how the creation and use of technologies consumes renewable and nonrenewable resources and creates waste.

Grades 6–8**3.3.6-8.G Earth and Space Science: History of Earth**

Students who demonstrate understanding can *analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.*

Clarifying Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).

Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. - Analyze and interpret data to provide evidence for phenomena. Connections to Nature of Science Scientific Knowledge is Open to Revision in Light of New Evidence - Science findings are frequently revised and/or reinterpreted based on new evidence.	The History of Planet Earth - Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. Plate Tectonics and Large Scale System Interactions - Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.	Patterns Patterns in rates of change and other numerical relationships can provide information about natural systems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania quarries, mines, caves, plate tectonics, and erosion.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). CC.3.5.6-8.I: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.2.6.B.2: Understand the process of solving a one-variable equation or inequality and apply it to real-world and mathematical problems. CC.2.2.7.B.3: Model and solve real-world and mathematical problems by using and connecting numerical, algebraic, and/or graphical representations.
PA Standards: Social Studies	7.2.6.A: Describe the characteristics of places and regions.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.3.6-8.H Earth and Space Science: Earth's Systems**

Students who demonstrate understanding can *develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.*

Clarifying Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.

Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms.	The Roles of Water in Earth's Surface Processes - Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. - Global movements of water and its changes in form are propelled by sunlight and gravity.	Energy and Matter Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the investigation of local watersheds that may be considered the basis for developing a model of the hydrologic cycle, the evolution of potholes from the hydrologic cycle, and glaciation in Pennsylvania's past.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	N/A

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Standards: Social Studies	7.2.6.B: Describe the physical processes that shape patterns on Earth's surface.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-3E: Analyze how different technological systems often interact with economic, environmental, and social systems.

Grades 6–8**3.3.6-8.I Earth and Space Science: Weather and Climate**

Students who demonstrate understanding can *develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.*

Clarifying Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.

Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	The Roles of Water in Earth’s Surface Processes - Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. Weather and Climate - Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. - The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.	Systems and System Models Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania’s latitude, altitude, and geography, and considerations of the potential impact on Pennsylvania and regional climate caused by changes in the jet stream.

PA Career Ready Skills: Explain to others one’s own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models. 5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	7.2.6.A: Describe the characteristics of places and regions.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2N: Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Grades 6–8**3.3.6-8.J Earth and Space Science: Weather and Climate**

Students who demonstrate understanding can *collect data to provide evidence for how the motion and complex interactions of air masses result in changes in weather conditions.*

Clarifying Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).

Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.	The Roles of Water in Earth's Surface Processes - The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. Weather and Climate - Because these patterns are so complex, weather can only be predicted probabilistically.	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to data for how Pennsylvania's weather is influenced by contexts such as continental air masses from the west or coastal air masses from the Atlantic Ocean and lake-effect weather conditions.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.I: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. CC.3.6.6-8.G: Gather relevant information from multiple print and digital resources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of other while avoiding plagiarism and following a standard format for citation.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.6.E.4: Apply and extend previous understandings of numbers to the system of rational numbers.
PA Standards: Social Studies	7.4.7.A: Describe and explain the effects of the physical systems on people within regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-2N: Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Grades 6–8

3.3.6-8.K Earth and Space Science: Earth's Systems

Students who demonstrate understanding can *construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.*

Clarifying Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Natural Resources Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.	Cause and Effect - Cause and effect relationships may be used to predict phenomena in natural or designed systems. Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World - All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's minerals, such as limestone, aggregates, iron, and groundwater resources.

PA Career Ready Skills: Explain how expressive communication strategies can affect others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research.
PA Core Standards and Practices: Math	CC.2.2.6.B.2: Understand the process of solving a one-variable equation or inequality and apply it to real-world and mathematical problems. CC.2.2.7.B.3: Model and solve real-world and mathematical problems by using and connecting numerical, algebraic, and/or graphical representations.
PA Standards: Social Studies	7.2.6.A: Describe the characteristics of places and regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4L: Analyze how the creation and use of technologies consumes renewable and nonrenewable resources and creates waste.

Grades 6–8**3.3.6-8.L Earth and Space Science: Human Impacts**

Students who demonstrate understanding can *analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.*

Clarifying Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings.	Natural Hazards Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.	Patterns - Graphs, charts, and images can be used to identify patterns in data. Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World - The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to analyzing and interpreting data on flooding as a natural disaster in Pennsylvania. Other Pennsylvania-specific hazards include wildland fires and tornadoes.

PA Career Ready Skills: Identify and select coping skills relevant to adverse situations.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.c: Evaluate the importance of technology use and how it impacts AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	CC.2.2.6.B.2: Understand the process of solving a one-variable equation or inequality and apply it to real-world and mathematical problems. CC.2.2.7.B.3: Model and solve real-world and mathematical problems by using and connecting numerical, algebraic, and/or graphical representations.
PA Standards: Social Studies	7.4.7.A: Describe and explain the effects of the physical systems on people within regions.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-1K: Compare and contrast the contributions of science, engineering, mathematics, and technology in the development of technological systems.

Grades 6–8**3.3.6-8.M Earth and Space Science:** Human Impacts

Students who demonstrate understanding can *apply scientific principles to design a method for monitoring and minimizing human impact on the environment.*

Clarifying Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.	Human Impacts on Earth Systems - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. - Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	Cause and Effect - Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World - The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to design methods for monitoring and maximizing the sustainable use of agricultural soils, collecting data from streams related to human impact on water, and methods for minimizing the impact of land use.

PA Career Ready Skills: Identify and select coping skills relevant to adverse situations.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.3.A. Human-environment interactions: Learners describe human-caused changes that affect the immediate environment as well as other places, other people, and future times. 5-8 Strand 3.1.C. Identifying and critiquing alternative solutions and courses of action: Learners identify and develop action strategies, including design solutions, appropriate for addressing a range of environmental issues at community and regional levels. They describe how their action strategies and design solutions might impact environmental quality and other people now and in the future.
PA Core Standards: ELA	CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. CC.3.6.6-8.G: Gather relevant information from multiple print and digital resources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of other while avoiding plagiarism and following a standard format for citation.
PA Core Standards and Practices: Math	CC.2.1.6.D.1: Understand ratio concepts and use ratio reasoning to solve problems. CC.2.1.7.D.1: Analyze proportional relationships and use them to model and solve real-world and mathematical problems.
PA Standards: Social Studies	7.4.6.B: Describe and explain the effects of people on the physical systems within regions.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-4M: Devise strategies for reducing, reusing, and recycling waste caused from the creation and use of technology. STEL-7U: Evaluate the strengths and weaknesses of different design solutions.

Grades 6–8
3.3.6-8.N Earth and Space Science: Human Impacts

Students who demonstrate understanding can *construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems.*

Clarifying Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	Human Impacts on Earth Systems Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	Cause and Effect - Cause and effect relationships may be used to predict phenomena in natural or designed systems. Energy and Matter - The transfer of energy can be tracked as energy flows through a natural system. Connections to Nature of Science Science Addresses Questions About the Natural and Material World - Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World - All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to consumption and use of Pennsylvania's food and natural resources such as wood, water, and fossil fuels.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.02.b: Analyze and assess sustainability practices that can be applied in AFNR systems (e.g., energy efficiency, recycle/re-use/repurpose, green resources, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.3.A. Human-environment interactions: Learners describe human-caused changes that affect the immediate environment as well as other places, other people, and future times. 5-8 Strand 2.3.B. Resource distribution and consumption: Learners explain that uneven geographic distribution of natural resources influences their use and perceived value.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.A: Write arguments focused on discipline-specific content. CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research.
PA Core Standards and Practices: Math	CC.2.1.6.D.1: Understand ratio concepts and use ratio reasoning to solve problems. CC.2.1.7.D.1: Analyze proportional relationships and use them to model and solve real-world and mathematical problems.
PA Standards: Social Studies	6.1.6.B: Compare ways that people meet their needs with how they meet their wants. Describe how resources are combined to produce different goods and services.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4L: Analyze how the creation and use of technologies consumes renewable and nonrenewable resources and creates waste.

Grades 6–8**3.3.6-8.O Earth and Space Science: Weather and Climate**

Students who demonstrate understanding can ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Clarifying Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Asking Questions and Defining Problems Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. Ask questions to identify and clarify evidence of an argument.	Global Climate Change Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.	Stability and Change Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to heat islands, consumption of fossil fuels, industrial centers, and methane from livestock in Pennsylvania.

PA Career Ready Skills: Interact with others demonstrating respect, cooperation, and acceptance.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.3.A. Human-environment interactions: Learners describe human-caused changes that affect the immediate environment as well as other places, other people, and future times. 5-8 Strand 3.1.A. Identifying and investigating issues: Learners use primary and secondary sources of information and apply research and analytical skills to investigate environmental issues, beginning in their own community and region.
PA Core Standards: ELA	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts.
PA Core Standards and Practices: Math	CC.2.2.6.B.2: Understand the process of solving a one-variable equation or inequality and apply it to real-world and mathematical problems.
PA Standards: Social Studies	7.4.6.B: Describe and explain the effects of people on the physical systems within regions.
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-4K: Examine the ways that technology can have both positive and negative effects at the same time.

Grades 6–8**3.4.6-8.A Environmental Literacy and Sustainability:** Agricultural and Environmental Systems and Resources

Students who demonstrate understanding can *develop a model to describe how agricultural and food systems function, including the sustainable use of natural resources and the production, processing, and management of food, fiber, and energy.*

Clarifying Statement: Emphasis is on models that use inputs and outputs to highlight the lifecycle of food and fiber products.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	Natural Resources - Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. Human Impacts on Earth Systems - Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	Systems and System Models Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania agriculture, urban agriculture, the aquaculture industry, manufacturing, recreational businesses, electricity and power, mining, biotechnology, forest products, and transportation industries.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.). CS.04.01.01.b: Analyze available practices to steward natural resources in AFNR systems (e.g., wildlife and land conservation, soil and water practices, ecosystem management, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models. 5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
PA Standards: Social Studies	6.1.6.A: Explain how limited resources and unlimited wants cause scarcity.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2N: Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Grades 6–8**3.4.6-8.B Environmental Literacy and Sustainability:** Agricultural and Environmental Systems and Resources

Students who demonstrate understanding can *analyze and interpret data about how different societies (economic and social systems) and cultures use and manage natural resources differently.*

Clarifying Statement: Emphasis is on comparing and contrasting data from two or more societies and cultures to draw evidence-based conclusions. Examples could include how different societies and cultures manage agriculture, recycling and waste management, fossil fuels, land development, and so on.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings.	Natural Resources - Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. Human Impacts on Earth Systems - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things.	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Identify conflict resolution skills to deescalate, diffuse, and resolve differences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.02.01.b: Analyze natural resources trends and technologies and explain how they impact AFNR systems (e.g., climate change, green technologies, water resources, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 2.2.B. Culture: Learners describe examples of the interconnection between cultural perspectives and the environment.
PA Core Standards: ELA	CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
PA Standards: Social Studies	7.4.6.B: Describe and explain the effects of people on the physical systems within regions.
Educational Technology (ISTE)	1.7. Global Collaborator: Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.
Technology and Engineering (ITEEA)	STEL-3E: Analyze how different technological systems often interact with economic, environmental, and social systems.

Grades 6–8**3.4.6-8.C Environmental Literacy and Sustainability:** Agricultural and Environmental Systems and Resources

Students who demonstrate understanding can *develop a model to describe how watersheds and wetlands function as systems, including the roles and functions they serve.*

Clarifying Statement: Examples of models could include pictorial (2D), abstract, concrete (3D), and computer-simulated models.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena.	Interdependent Relationships in Ecosystems - Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. - In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. Ecosystem Dynamics, Functioning, and Resilience - Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. The Roles of Water in Earth's Surface Processes - Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.	Systems and System Models - Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. Structure and Function - Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania waterways, watersheds, stormwater runoff, erosion, sediment, nutrient load, flooding, and wetlands.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.F. Working with models and simulations: Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models. 5-8 Strand 2.1.A. Earth's physical systems: Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
PA Core Standards: ELA	CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models. CC.2.4.7.B.1: Draw inferences about populations based on random sampling concepts.
PA Standards: Social Studies	7.4.7.A: Describe and explain the effects of the physical systems on people within regions.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2N: Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Grades 6–8**3.4.6-8.D Environmental Literacy and Sustainability:** Environmental Literacy Skills

Students who demonstrate understanding can *gather, read, and synthesize information from multiple sources to investigate how Pennsylvania environmental issues affect Pennsylvania's human and natural systems.*

Clarifying Statement: Examples could include sediment and nutrient loads in Pennsylvania waterways, indoor and outdoor air quality, urban heat islands, and so on.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.	Human Impacts on Earth Systems - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. Ecosystem Dynamics, Functioning, and Resilience - Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.	Cause and Effect - Cause and effect relationships may be used to predict phenomena in natural or designed systems. Stability and Change - Small changes in one part of a system might cause large changes in another part.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania-specific laws, policies, regulations, and agreements such as the Pennsylvania Environmental Plan, Pennsylvania Environmental Rights Amendment, and Chesapeake Bay Agreement; and Pennsylvania agencies and departments such as the Department of Environmental Protection, Department of Conservation and Natural Resources, Bureau of Forestry, Commission for Agricultural Education, Fish and Boat Commission, and Game Commission.

PA Career Ready Skills: Distinguish among various social contexts and how they impact personal feelings.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.02.a: Read and interpret the definition of sustainability and summarize how it relates to AFNR activities.
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.C. Collecting information: Learners locate and collect quantitative and qualitative information about the environment and environmental topics, using a range of methods and sources. They explain why they used selected information collection methods. 5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.
PA Core Standards: ELA	CC.3.5.6-8.I: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
PA Standards: Social Studies	7.4.6.B: Describe and explain the effects of people on the physical systems within regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3E: Analyze how different technological systems often interact with economic, environmental, and social systems.

Grades 6–8**3.4.6-8.E Environmental Literacy and Sustainability:** Environmental Literacy Skills

Students who demonstrate understanding can *collect, analyze, and interpret environmental data to describe a local environment.*

Clarifying Statement: Emphasis is on collecting information from a local outdoor area in order to accurately describe that environment. Examples could include weather data, stream studies, data on air quality, biodiversity assessments, and so on.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings.	Interdependent Relationships in Ecosystems - Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. Weather and Climate - Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.	Patterns Patterns in rates of change and other numerical relationships can provide information about natural systems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local Pennsylvania colleges and universities, nature centers, Pennsylvania Conservation Districts, and science museums.

PA Career Ready Skills: Interact with others demonstrating respect, cooperation, and acceptance.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.C. Collecting information: Learners locate and collect quantitative and qualitative information about the environment and environmental topics, using a range of methods and sources. They explain why they used selected information collection methods. 5-8 Strand 2.1.B. Earth's living systems: Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.
PA Core Standards: ELA	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models. CC.2.4.7.B.1: Draw inferences about populations based on random sampling concepts.
PA Standards: Social Studies	7.2.6.A: Describe the characteristics of places and regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.4.6-8.F Environmental Literacy and Sustainability:** Environmental Literacy Skills

Students who demonstrate understanding can *obtain and communicate information on how integrated pest management could improve indoor and outdoor environments.*

Clarifying Statement: Examples of methods of integrated pest management may include biological (e.g., managing indoor air quality), cultural (e.g., planting locally pest-resistant crops or crop rotation), mechanical (e.g., trapping pests), and chemical (e.g., cleaning surfaces in schools) treatments of invasives; materials and procedures for cleaning surfaces and air in schools; and maintaining or promoting biodiversity.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence.	Human Impacts on Earth Systems Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.	Stability and Change - Small changes in one part of a system might cause large changes in another part. Cause and Effect - Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania farms (agriculture, urban agriculture, and aquaculture), businesses, and biotechnology industries.

PA Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.03.02.01.c: Create and implement a plan to improve safety, health and environmental management regulations in an AFNR workplace.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.C. Collecting information: Learners locate and collect quantitative and qualitative information about the environment and environmental topics, using a range of methods and sources. They explain why they used selected information collection methods. 5-8 Strand 3.2.C. Planning and taking action: Learners use their research results to develop action strategies and design solutions at levels consistent with their maturity and preparation. As appropriate, they implement their plans.
PA Core Standards: ELA	CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research. CC.3.6.6-8.E: Use technology, including the internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models.
PA Standards: Social Studies	6.1.6.D: Identify incentives that affect personal choices.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.4.6-8.G Environmental Literacy and Sustainability:** Sustainability and Stewardship

Students who demonstrate understanding can *obtain and communicate information to describe how best resource management practices and environmental laws are designed to achieve environmental sustainability.*

Clarifying Statement: Emphasis is on the intended outcomes of best management practices (e.g., stormwater, forest, land use, wildlife, and waste management) and environmental laws (i.e., international, federal, state, and local jurisdictions).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence.	Human Impacts on Earth Systems - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. Developing Possible Solutions - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	Cause and Effect - Cause and effect relationships may be used to predict phenomena in natural or designed systems. Stability and Change - Small changes in one part of a system might cause large changes in another part.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania-specific laws, policies, regulations, and agreements such as the Pennsylvania Environmental Plan, Pennsylvania Environmental Rights Amendment, and Chesapeake Bay Agreement; and Pennsylvania agencies and departments such as the Department of Environmental Protection, Department of Conservation and Natural Resources, Bureau of Forestry, Commission for Agricultural Education, Fish and Boat Commission, and Game Commission.

PA Career Ready Skills: Identify conflict resolution skills to deescalate, diffuse, and resolve differences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.02.c: Evaluate sustainability policies and plans and prepare summary of potential improvements for AFNR businesses or organizations.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	5-8 Strand 1.C. Collecting information: Learners locate and collect quantitative and qualitative information about the environment and environmental topics, using a range of methods and sources. They explain why they used selected information collection methods. 5-8 Strand 3.2.C. Planning and taking action: Learners use their research results to develop action strategies and design solutions at levels consistent with their maturity and preparation. As appropriate, they implement their plans.
PA Core Standards: ELA	CC.3.6.6-8.E: Use technology, including the internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently. CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.1: Draw inferences about populations based on random sampling concepts. association can be seen in bivariate data utilizing frequencies.
PA Standards: Social Studies	7.4.6.B: Describe and explain the effects of people on the physical systems within regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.4.6-8.H Environmental Literacy and Sustainability:** Sustainability and Stewardship

Students who demonstrate understanding can *design a solution to an environmental issue in which individuals and societies can engage as stewards of the environment.*

Clarifying Statement: Examples of design solutions could include written or drawn plans, as well as implementing project actions.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Developing Possible Solutions - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Human Impacts on Earth Systems - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.	Connections to Nature of Science Science Addresses Questions About the Natural and Material World Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania Environmental Justice Area designations or Environmental Health Indicators.

PA Career Ready Skills: Distinguish among various social contexts and how they impact personal feelings.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 3.1.C. Identifying and critiquing alternative solutions and courses of action: Learners identify and develop action strategies, including design solutions, appropriate for addressing a range of environmental issues at community and regional levels. They describe how their action strategies and design solutions might impact environmental quality and other people now and in the future.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.6.B.1: Demonstrate an understanding of statistical variability by displaying, analyzing, and summarizing distributions. CC.2.4.7.B.3: Investigate chance processes and develop, use, and evaluate probability models.
PA Standards: Social Studies	7.4.6.B: Describe and explain the effects of people on the physical systems within regions.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-7Q: Apply the technology and engineering design process.

Grades 6–8**3.4.6-8.I Environmental Literacy and Sustainability:** Sustainability and Stewardship

Students who demonstrate understanding can *construct an explanation that describes regional environmental conditions and their implications on environmental justice and social equity.*

Clarifying Statement: Examples include both current and historical conditions due to systemic inequalities, including but not limited to human health impacted by Superfund sites, air quality, urban heat islands, acid mine drainage, access to green space, biodiversity, and water quality. Explanations could be constructed using primary and secondary sources, both print and digital.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.	Biodiversity and Humans Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania Environmental Justice Area designations or Environmental Health Indicators.

PA Career Ready Skills: Explain how expressive communication strategies can affect others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.02.c: Evaluate sustainability policies and plans and prepare summary of potential improvements for AFNR businesses or organizations.
Science, Environmental Literacy and Sustainability (NAEE)	5-8 Strand 2.3.A. Human-environment interactions: Learners describe human-caused changes that affect the immediate environment as well as other places, other people, and future times.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.6.6-8.H: Draw evidence from informational texts to support analysis reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.8.B.1: Analyze and/or interpret bivariate data displayed in multiple representations. CC.2.4.8.B.2: Understand that patterns of association can be seen in bivariate data utilizing frequencies.
PA Standards: Social Studies	7.4.6.B: Describe and explain the effects of people on the physical systems within regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-3G: Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 6–8**3.5.6-8.A Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *research information from various sources to use and maintain technological products or systems.*

Clarifying Statement: Written and graphical information is helpful in learning how to use a product and determining if it works properly. In addition, many manuals provide tips on how to troubleshoot a product or system.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.	Developing Possible Solutions Models of all kinds are important for testing solutions.	Communication Exhibits effective technical writing, graphic, and oral communication abilities.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's academic and research institutions.

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6-8**3.5.6-8.B Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can use instruments to gather data on the performance of everyday products.

Clarifying Statement: Students should use evidence to make more complex technology assessment decisions. For example, monitoring the power produced by a photovoltaic system will allow students to determine if the system is operating according to its rated output

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends.	Developing Possible Solutions - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Information Research - Select and use appropriate digital and network tools and media resources to collect, organize, analyze, and display supporting data to answer questions and test hypotheses.	Systems Thinking Uses the systems model to show how parts of technological systems work together.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's Public Utility Commission.

Pennsylvania Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6-8**3.5.6-8.C Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *hypothesize what alternative outcomes (individual, cultural, and/or environmental) might have resulted had a different technological solution been selected.*

Clarifying Statement: Development of technologies typically proceeds from a set of criteria identified through analysis of a need or want. Using specific technological examples, students can investigate the positive and negative outcomes of their use and consider how these outcomes could have been altered, given emphasis on different design criteria.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	Investigation of Academic and Practical Problems Use a digital model of a system to conduct a simulation. Explain how changes in the model result in different outcomes.	Attention to Ethics Shows an understanding of ways to regulate technologies and the reasons for doing so.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to robotic industries and agriculture industries.

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6-8**3.5.6-8.D Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *analyze how the creation and use of technologies consumes renewable, non-renewable, and inexhaustible resources; creates waste; and may contribute to environmental challenges.*

Clarifying Statement: Building on students' knowledge about material resources and their growing understanding of sustainable resource use will provide opportunities for learning about methods of accessing resources (e.g., harvesting, mining, drilling) and the by-products of these activities.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	Effects of Technology on the Natural World - Compare the environmental effects of alternative technologies devised to solve the same problem or accomplish the same goal and justify which choice is best, taking into account environmental impacts as well as other relevant factors. - Some technological decisions involve trade-offs between environmental and economic needs, while others have positive effects for both the economy and environment.	Attention to Ethics Shows an understanding of ways to regulate technologies and the reasons for doing so.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to fracking and the extraction of natural gas and oil.

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.6-8.M: Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

Grades 6–8**3.5.6-8.E Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *consider the impacts of a proposed or existing technology and devise strategies for reducing, reusing, and recycling waste caused by its creation.*

Clarifying Statement: Given specific examples in their home or community, middle grade students should be able to consider various options for minimizing or managing resource use (waste) and select or design practical strategies for waste reduction.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.	Interaction of Technology and Humans Describe and analyze positive and negative impacts on society from the introduction of a new or improved technology, including both expected and unanticipated effects.	Optimism Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to waste removal and recycling facilities.

Pennsylvania Career Ready Skills: Make a decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.F Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *analyze examples of technologies that have changed the way people think, interact, live, and communicate.*

Clarifying Statement: At this age, students should be able to identify and discuss specific examples of technologies that have led to fundamental changes in humans. Obvious examples include things like social media and smartphones; students should be encouraged to dig deeper and identify less obvious technologies.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).	Interaction of Technology and Humans Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.	Critical Thinking Defends technological decisions based on evidence.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Explain how expressive communication strategies can affect others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.7: Look for and make use of structure.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.G Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *analyze how an invention or innovation was influenced by the context and circumstances in which it is developed.*

Clarifying Statement: Characteristics of technologies are the result of the circumstances in which they are developed. Economic, political, cultural, and environmental drivers create historical contexts and determine the design of technology and its level of acceptance. For example, over the past decade, lighting technology has evolved considerably, with LED bulbs largely replacing both incandescent and compact fluorescent lighting as a result of people seeking more efficient, long-lasting, and more environmentally benign lighting solutions.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).	Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	Critical Thinking Defends technological decisions based on evidence.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Distinguish among various social contexts and how they impact personal feelings.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.H Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can evaluate trade-offs based on various perspectives as part of a decision process that recognizes the need for careful compromises among competing factors.

Clarifying Statement: Technological developments come with both benefits and consequences. A trade-off is a compromise in which one thing is given up in order to get something else that is desired. Students should recognize that a society's expectation for new and unique products contributes to design for obsolescence and to unsustainable rates of consumption.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Evaluate competing design solutions based on jointly developed and agreed-upon design criteria	Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	Optimism Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to waste removal and recycling facilities.

Pennsylvania Career Ready Skills: Make a decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.I Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *examine the ways that technology can have both positive and negative effects at the same time.*

Clarifying Statement: The form and function of technologies are shaped by the criteria considered when the technology is developed. Even beneficial and well-intentioned solutions can have negative impacts. For example, flush toilets led to improved health and hygiene; at the same time, they created a need for water treatment strategies that consume large amounts of energy and fresh water. This type of example provides students an opportunity to consider the importance of design criteria.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).	Interaction of Technology and Humans Describe and analyze positive and negative impacts on society from the introduction of a new or improved technology, including both expected and unanticipated effects.	Attention to Ethics Shows an understanding of ways to regulate technologies and the reasons for doing so.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.7: Look for and make use of structure.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.6-8.M: Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

Grades 6–8**3.5.6-8.J Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can use tools, materials, and machines to safely diagnose, adjust, and repair systems.

Clarifying Statement: For many consumer products, federal and state laws require safety information. Safety procedures should be learned through formal education and teacher demonstration. Tools are used by students for diagnosis, adjustments, and repair. For example, when the cutting bit on a computer numerically- controlled (CNC) lathe wears down, adjustments need to be made to the alignment of the cutting bit to the raw stock.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.	Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Systems Thinking - Uses the systems model to show how parts of technological systems work together.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania Department of Labor & Industry regulations.

Pennsylvania Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.K Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *use devices to control technological systems.*

Clarifying Statement: Students should be familiar with and use sensors to control technological systems such as robotic devices, alternative energy vehicles, and other technologies. Many machines are equipped with other types of safety devices to protect the user.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends.	Automation & Algorithmic Thinking Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Systems Thinking - Uses the systems model to show how parts of technological systems work together.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses.

Pennsylvania Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.L Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *design methods to gather data about technological systems.*

Clarifying Statement: Examples include devices designed to test water or air quality, performance tests to assess things like accuracy or speed, destructive testing to analyze strength and durability of materials, and so on.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.	Selection and Use of Digital Tools Use appropriate digital tools to accomplish a variety of tasks, including gathering, analyzing, and presenting information as well as creating text, visualizations, and models and communicating with others.	Making and Doing Exhibits safe, effective ways of producing technological products, systems, and processes.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Identify and evaluate distractors that impact reaching ones' goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.M (ETS) Technology and Engineering:** Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can *develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.*

Clarifying Statement: The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.	Developing Possible Solutions - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. - Models of all kinds are important for testing solutions. Optimizing the Design Solution - The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	Optimism Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Identify and evaluate distractors that impact reaching ones' goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8

3.5.6-8.N (ETS) Technology and Engineering: Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can *analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.*

Clarifying Statement: There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings.	Developing Possible Solutions - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. - Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Optimizing the Design Solution - Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.	Optimism Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). CC.3.5.6-8.I: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.O Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *interpret the accuracy of information collected.*

Clarifying Statement: Developing specific criteria for what information is useful is important in making these judgments. Sometimes determining accuracy is easy—taking information from physical measuring devices like a water-purity tester, for example. At other times, accuracy is more difficult to determine, as when assessments are based on public opinion, which can differ greatly from group to group.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings.	Evaluate Information Students evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.	Communication Exhibits effective technical writing, graphic, and oral communication abilities.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's utility industries and the Pennsylvania Public Utility Commission.

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.P (ETS) Technology and Engineering:** Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Clarifying Statement: There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	Critical Thinking Defends technological decisions based on evidence.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Explain how expressive communication strategies can affect others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.I: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. CC.3.6.6-8.F: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. CC.3.6.6-8.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.Q Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can apply a technology and engineering design thinking process.

Clarifying Statement: Students intentionally use a technology and engineering design thinking process to iteratively solve design challenges. Students begin to recognize the value of revisiting steps in the design thinking process to avoid fixation on one solution.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results in order to improve it. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Creativity - Exhibits innovative and original ideas in the context of design-based activities.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvanian academic and research institutions.

Pennsylvania Career Ready Skills: Explain how empathy and perspective taking foster relationship building.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.R Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can *develop innovative products and systems that solve problems and extend capabilities based on individual or collective needs and wants.*

Clarifying Statement: For example, the news is full of stories about young innovators such as Marie Elena Grimmer, who at age 14 developed a system for using recyclable plastic beads to filter out a harmful antibiotic used to treat livestock and commonly found in water supplies in rural areas. This development process entails the important step of problem finding, which often results from needs or wants that students have identified in their own lives or the lives of family members.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.	Developing Possible Solutions - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. - Models of all kinds are important for testing solutions. - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. - Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.	Making and Doing Exhibits safe, effective ways of producing technological products, systems, and processes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Interact with others demonstrating respect, cooperation, and acceptance.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.S Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can *illustrate the benefits and opportunities associated with different approaches to design.*

Clarifying Statement: A characteristic of design is weighing the benefits and opportunities associated with the approach a designer selects. It is important to consider these carefully when choosing the final approach to be selected in solving a problem.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.	Developing Possible Solutions Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.	Optimism Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.T Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can *create solutions to problems by identifying and applying human factors in design.*

Clarifying Statement: Students acknowledge that the process of design is influenced by human factors and broaden their ability to identify and apply human factors such as ease of use and ergonomics.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.	Engineering Design Communicate the results of a design process and articulate the reasoning behind design decisions by using verbal and visual means. Identify the benefits of a design as well as the possible unintended consequences.	Making and Doing Exhibits safe, effective ways of producing technological products, systems, and processes.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Identify conflict resolution skills to deescalate, diffuse, and resolve differences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.6-8.M: Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

Grades 6–8**3.5.6-8.U Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can evaluate and assess the strengths and weaknesses of various design solutions given established principles and elements of design.

Clarifying Statement: Students assess quality in designs based in part upon the principles and elements of design. With teacher guidance, students in this grade band can articulate reasons why they believe some designs are more effective than others.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.	Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	Optimism Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.V Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can *refine design solutions to address criteria and constraints.*

Clarifying Statement: Students design within provided criteria and constraints and recognize trade-offs associated with optimization.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Optimism - Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's food production industries.

Pennsylvania Career Ready Skills: Make a decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8

3.5.6-8.W (ETS) Technology and Engineering: Design Thinking in Technology & Engineering Education

Students who demonstrate understanding can *define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.*

Clarifying Statement: The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	Critical Thinking Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Make a decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.6.6-8.G: Gather relevant information from multiple print and digital resources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.X Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can defend decisions related to a design problem.

Clarifying Statement: By requiring students to defend their actions and communicate their findings after attempting to solve a problem, students develop empathy, flexible thinking, accountability, and metacognition skills (i.e., awareness and understanding of their own thought processes). Helping students develop technology and engineering habits of mind involves the teacher explicitly modeling, teaching, and providing students with opportunities to demonstrate expected behaviors.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	Critical Thinking Defends technological decisions based on evidence.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Explain how expressive communication strategies can affect others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.Y Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *compare, contrast, and identify overlap between the contributions of science, technology, engineering, and mathematics in the development of technological systems.*

Clarifying Statement: Students at this level can discern the contributions the fields of science, engineering, mathematics, and technology (as well as other disciplines) contribute to the advancement of technological tools and systems. One way this can be accomplished is by evaluating a completed engineering design task and identifying the elements from other academic disciplines that contributed to the completion of the task.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).	Nature of Technology Science is the systematic investigation of the natural world. Technology is any modification of the environment to satisfy people's needs and wants. Engineering is the process of creating or modifying technologies and is constrained by physical laws and cultural norms, and economic resources.	Collaboration Exhibits effective technical writing, graphic, and oral communication abilities.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses and industries.

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.Z Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *analyze how different technological systems often interact with economic, environmental, and social systems.*

Clarifying Statement: For example, a navigation system in a delivery vehicle uses sensors that provide input to the distribution center and sends customers notifications when their products are delivered. If a package is delivered to a wrong address, GPS data can accurately determine the location to which the package was actually delivered.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.	Interaction of Technology and Humans Economic, political, social, and cultural aspects of society drive improvements in technological products, processes, and systems	Systems Thinking - Uses the systems model to show how parts of technological systems work together. Attention to Ethics - Shows an understanding of ways to regulate technologies and the reasons for doing so.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania water and wastewater facilities and processes.

Pennsylvania Career Ready Skills: Distinguish among various social contexts and how they impact personal feelings.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.AA Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can adapt and apply an existing product, system, or process to solve a problem in a different setting.

Clarifying Statement: Technology transfer is a creative way for people to address needs and wants. For instance, an automated pump based on biology laboratory designs was created for the Mars Viking space probe. The pump was modified for use as an insulin delivery mechanism, providing patients with a way to automatically regulate blood sugar. In classrooms, this concept is often already implicitly achieved as students apply existing technologies in novel ways. An example that may be highlighted is the use of a microcontroller to solve a design problem.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.	Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of these characteristics may be incorporated into the new design.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Creativity - Exhibits innovative and original ideas in the context of design-based activities.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's academic and research institutions, programs, inventions, and maker spaces.

Pennsylvania Career Ready Skills: Identify and evaluate distractors that impact reaching ones' goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.6-8.M: Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

Grades 6–8**3.5.6-8.BB Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *demonstrate how knowledge gained from other content areas affects the development of technological products and systems.*

Clarifying Statement: Skills learned in fine arts are used in designing and rendering examples of technological products and systems. Studying the history of technology and engineering provides people with a way to learn from past successes and challenges. A tangible example can be seen as students demonstrate an applied knowledge of Newton's Laws of Motion in the construction, testing, and evaluation of roller coasters, rockets, or dragsters.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings.	Optimizing the Design Solution The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Optimism - Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses and industries.

Pennsylvania Career Ready Skills: Identify and evaluate distractors that impact reaching ones' goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.CC Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *consider historical factors that have contributed to the development of technologies and human progress.*

Clarifying Statement: For example, students can examine maps in a historical context and decipher how geography and availability of natural resources often determined the materials humans used for shelter.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	Developing Possible Solutions - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. - Models of all kinds are important for testing solutions	Optimism Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local examples of Pennsylvania’s food production, agriculture, urban agriculture, and aquaculture.

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.3.5.6-8.A: Cite specific textual evidence to support analysis of science and technical texts. CC.3.5.6-8.G: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). CC.3.5.6-8.I: Compare and contrast information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
PA Core Standards and Practices: Math	N/A

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.DD Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can engage in a research and development process to simulate how inventions and innovations have evolved through systematic tests and refinements.

Clarifying Statement: For example, in 1879 the first light bulb burned for only 13 hours. Since that time there have been many innovations and design changes to Edison's light bulb. Students can research the timeline of a given technology, noting the significant changes and what those changes have meant to society and the environment.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	Developing Possible Solutions Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.	Optimism Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Identify and evaluate distractors that impact reaching ones' goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.EE Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *differentiate between inputs, processes, outputs, and feedback in technological systems.*

Clarifying Statement: Inputs consist of the resources that flow into a technological system. The processes are the systematic sequences of actions that combine resources to produce an output, encoding, reproducing, designing, assembling, or propagating, for example. The output is the result, which can have both positive or negative impacts. Feedback is information used to monitor or control a system. A system often includes a component that permits revising or refining the system when the feedback suggests such action. For example, the fuel level indicator of a vehicle is a feedback system that lets the user know when the system needs additional fuel.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).	Systems Thinking Technological systems are designed to achieve goals. They incorporate various processes that transform inputs into outputs. They all use energy in some form. These processes may include feedback and control.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Systems Thinking - Uses the systems model to show how parts of technological systems work together.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses and industries.

Pennsylvania Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.FF Technology and Engineering: Nature and Characteristics of Technology and Engineering**

Students who demonstrate understanding can *demonstrate how systems thinking involves considering relationships between every part, as well as how the systems interact with the environment in which it is used.*

Clarifying Statement: Systems are used in a number of ways. Systems also appear in many aspects of daily life, such as communication systems and transportation systems. Analyzing a system is done in terms of its individual parts or in terms of the whole system and how it interacts with or relates to other systems. For example, discussing a computer system may involve the particular parts of a single computer, or it may include an entire computer network. Discussing a transportation system may involve listing the various parts of a particular form of transport (e.g., airports, airplanes, air traffic control, airport security, etc.), or it may be discussed by comparing the overall attributes of one type of transportation system to another (e.g., the type of vehicles used, energy inputs, control mechanisms, and so on).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.	Systems Thinking Technological systems are designed to achieve goals. They incorporate various processes that transform inputs into outputs. They all use energy in some form. These processes may include feedback and control.	Systems Thinking - Uses the systems model to show how parts of technological systems work together. Attention to Ethics - Shows an understanding of ways to regulate technologies and the reasons for doing so.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the Pennsylvania Department of Agriculture's promotion of the use of integrated pest management for Pennsylvania growers, agribusiness, and pesticide users.

Pennsylvania Career Ready Skills: Distinguish among various social contexts and how they impact personal feelings.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.GG Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *create an open-loop system that has no feedback path and requires human intervention.*

Clarifying Statement: An example of an open-loop system is a light switch in a room. The electrical system has no feedback loop but requires someone to flip the switch (input) to send electrons to the bulb (process) and make light illuminate the room (output).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.	Developing Possible Solutions - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. - Models of all kinds are important for testing solutions.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Systems Thinking - Uses the systems model to show how parts of technological systems work together.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Identify and evaluate distractors that impact reaching ones' goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.HH Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *create a closed-loop system that has a feedback path and requires no human intervention.*

Clarifying Statement: Systems can be designed to utilize automated controls that both receive information from the system and take action based on the content of that feedback. An example is the water heater in a home, which has a thermostat to provide feedback and automatically adjusts the system when it needs to be turned on and off.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.	Developing Possible Solutions - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. - Models of all kinds are important for testing solutions.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Systems Thinking - Uses the systems model to show how parts of technological systems work together.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the automation of farming, manufacturing, and food production.

Pennsylvania Career Ready Skills: Identify and evaluate distractors that impact reaching ones' goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.II Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *predict outcomes of a future product or system at the beginning of the design process.*

Clarifying Statement: Careful designers consider possible outcomes of a technological product before the product is completed. This is a habit of mind that students should continually expand through design, problem solving, ideation, and systems thinking.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.	Optimizing the Design Solution The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately an optimal solution.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Systems Thinking - Uses the systems model to show how parts of technological systems work together.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the environmental impact of Pennsylvania’s sources of energy, such as wind, fossil, and hydroelectric power.

Pennsylvania Career Ready Skills: Make a decision based upon anticipated consequences.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others. MP.7: Look for and make use of structure.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.JJ Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can apply informed problem-solving strategies to the improvement of existing devices or processes or the development of new approaches.

Clarifying Statement: Design and problem -solving are seen as iterative processes that involve idea generating, making or building possible solutions, testing, and redesign. Creative problem-solving allows for new insights that lead to improvements such as greater efficiency, better performance, lower environmental impacts, and so on. For example, students learning about aerodynamics might devise modifications to a model rocket design to make it more streamlined and accurate.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	Optimizing the Design Solution The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately an optimal solution.	Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes. Optimism - Critiques technological products and systems to identify areas of improvement.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses and industries.

Pennsylvania Career Ready Skills: Identify and evaluate distractors that impact reaching ones' goals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.KK Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *explain how technology and engineering are closely linked to creativity, which can result in both intended and unintended innovations.*

Clarifying Statement: Creativity requires an individual to use knowledge and experience from different subjects to create something new or to use something in a new way. Many inventions are inspired by perceived needs and wants—the toothbrush, for example. At other times, inventions emerge in unexpected ways. For example, Stephanie Kwolek was working to find a replacement for steel cords in tires when she inadvertently invented Kevlar. Creatively exploring new ideas is often key to improvement of technological products and systems.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.	Nature of Technology Technology advances through the processes of innovation and invention. Sometimes a technology developed for one purpose is adapted to serve other purposes.	Critical Thinking - Defends technological decisions based on evidence. Making and Doing - Exhibits safe, effective ways of producing technological products, systems, and processes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Explain to others one's own strengths, needs, and preferences specific to a context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.7: Look for and make use of structure.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 6–8**3.5.6-8.LL Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *compare how different technologies involve different sets of processes.*

Clarifying Statement: For example, data processing includes designing, summarizing, storing, retrieving, reproducing, evaluating, and communicating information. The processes of construction include designing, developing, evaluating, making and producing, marketing, and managing.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).	Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	Systems Thinking Uses the systems model to show how parts of technological systems work together.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Analyze various perspectives on a situation.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12

3.1.9-12.A Life Science: Structure and Function

Students who demonstrate understanding can construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

Clarifying Statement: N/A

Assessment Boundary: Assessment does not include the identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Structure and Function - Systems of specialized cells within organisms help them perform the essential functions of life. - All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.	Structure and Function Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.G. Drawing conclusions and developing explanations: Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.B Life Science:** Structure and Function

Students who demonstrate understanding can *develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.*

Clarifying Statement: Emphasis is on functions at the organism system level, such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.

Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction levels.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	Structure and Function Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.	Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Pennsylvania Context: N/A

PA Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.F. Working with models and simulations: Learners create, use, test, and evaluate models to analyze environmental questions, problems, issues, or phenomena.
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.C Life Science:** Structure and Function

Students who demonstrate understanding can *plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.*

Clarifying Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.

Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	Structure and Function Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.	Stability and Change Feedback (negative or positive) can stabilize or destabilize a system.
Connections to Nature of Science Scientific Investigations Use a Variety of Methods Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.		

Pennsylvania Context: N/A

PA Career Ready Skills: Establish pro-social relationships to support self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.B. Designing investigations: Learners design investigations to explore environmental questions, problems, issues, phenomena, and models. They explain their reasoning.
PA Core Standards: ELA	CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. CC.3.6.9-10.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. CC.3.6.11-12.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.D Life Science:** Inheritance and Variation of Traits

Students who demonstrate understanding can *use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.*

Clarifying Statement: N/A

Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	Growth and Development of Organisms In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.	Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 1.F. Working with models and simulations: Learners create, use, test, and evaluate models to analyze environmental questions, problems, issues, or phenomena.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.2.HS.C.2: Graph and analyze functions and use their properties to make connections between the different representations.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.E Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.*

Clarifying Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.

Assessment Boundary: Assessment does not include specific biochemical steps.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.	Organization for Matter and Energy Flow in Organisms The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.	Energy and Matter Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems. 9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.F Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.*

Clarifying Statement: Emphasis is on using evidence from models and simulations to support explanations.

Assessment Boundary: Assessment does not include the details of specific chemical reactions or identification of macromolecules.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Organization for Matter and Energy Flow in Organisms - The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. - As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.	Energy and Matter Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.D: Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.G Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.*

Clarifying Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.

Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Use a model based on evidence to illustrate the relationships between systems or between components of a system.	Organization for Matter and Energy Flow in Organisms - As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. - As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.	Energy and Matter Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.H Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.*

Clarifying Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen, and nitrogen being conserved as they move through an ecosystem.

Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematical and Computational Thinking Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Cycles of Matter and Energy Transfer in Ecosystems Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.	Energy and Matter Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to examples of local Pennsylvania agriculture, urban agriculture, and aquaculture.

PA Career Ready Skills: Select expressive communication strategies specific to context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 3.1.B. Sorting out the consequences of issues: Learners evaluate the consequences of a broad range of environmental changes, conditions, and issues on environmental quality and long-term sustainability. They identify environmental justice and social equity implications.
PA Core Standards: ELA	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12

3.1.9-12.I Life Science: Interdependent Relationships in Ecosystems

Students who demonstrate understanding can *use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.*

Clarifying Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.

Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Interdependent Relationships in Ecosystems Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.	Scale Proportion and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to possible local connections to Pennsylvania native plants and wildlife populations, and to invasive species such as white-tailed deer, zebra mussels, lanternfly, garlic mustard, and ginkgo plants.

PA Career Ready Skills: Evaluate how societal conventions may influence the perspectives of individuals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 3.1.B. Sorting out the consequences of issues: Learners evaluate the consequences of a broad range of environmental changes, conditions, and issues on environmental quality and long-term sustainability. They identify environmental justice and social equity implications.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problem. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.J Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.*

Clarifying Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.

Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Cycles of Matter and Energy Transfer in Ecosystems Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.	Energy and Matter Energy drives the cycling of matter within and between systems.
Connections to Nature of Science Scientific Knowledge is Open to Revision in Light of New Evidence Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.		

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's food and beverage industry, wastewater treatment, and the agricultural industry.

PA Career Ready Skills: Select expressive communication strategies specific to context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.D: Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.K Life Science:** Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can *develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.*

Clarifying Statement: Examples of models could include simulations and mathematical models.

Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show how relationships among variables between systems and their components in the natural and designed world(s). Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	Cycles of Matter and Energy Transfer in Ecosystems - Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. Energy in Chemical Processes - The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.	Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Pennsylvania Context: N/A

PA Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.L Life Science:** Interdependent Relationships in Ecosystems

Students who demonstrate understanding can use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Clarifying Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.

Assessment Boundary: Assessment is limited to provided data.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Interdependent Relationships in Ecosystems - Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. Ecosystem Dynamics, Functioning, and Resilience - A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.	Scale Proportion and Quantity Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.
Connections to Nature of Science Scientific Knowledge is Open to Revision in Light of New Evidence Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.		

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to possible local connections to Pennsylvania native plants and wildlife populations, and to invasive species, such as white-tailed deer, zebra mussels, lanternfly, garlic mustard, and ginkgo plants.

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 3.1.B. Sorting out the consequences of issues: Learners evaluate the consequences of a broad range of environmental changes, conditions, and issues on environmental quality and long-term sustainability. They identify environmental justice and social equity implications.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	7.2.12.A: Analyze the physical characteristics of places and regions, including the interrelationships among the components of Earth's physical systems.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.M Life Science:** Interdependent Relationships in Ecosystems

Students who demonstrate understanding can *evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.*

Clarifying Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. - Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. Connections to Nature of Science Scientific Knowledge is Open to Revision in Light of New Evidence - Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.	Ecosystem Dynamics, Functioning, and Resilience A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.	Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local connections to Pennsylvania natural ecosystem changes, such as forest succession, natural disasters, and human impacts such as those related to resource extraction and use resulting in habitat destruction.

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 3.1.B. Sorting out the consequences of issues: Learners evaluate the consequences of a broad range of environmental changes, conditions, and issues on environmental quality and long-term sustainability. They identify environmental justice and social equity implications.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.HS.B.1: Summarize, represent, and interpret data on a single count or measurement variable. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	7.2.12.B: Analyze the significance of physical processes in shaping the character of places and regions.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.N Life Science:** Interdependent Relationships in Ecosystems

Students who demonstrate understanding can *design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

Clarifying Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Ecosystem Dynamics, Functioning, and Resilience - Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. Biodiversity and Humans - Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). - Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. Developing Possible Solutions - When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.	Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local connections to agriculture, invasive species, urbanization, and resource management for maintaining biodiversity and preserving the ecosystem.

PA Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community.
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.3.A. Human-environment interactions: Learners analyze ways that humans interact with their environment and how these interactions change with technological developments. Learners determine costs and benefits to different groups in society as well as unintended consequences. 9-12 Strand 3.2.D. Evaluating the results of actions: Learners evaluate the intended and unintended consequences of design solutions, their own civic actions and actions taken by other individuals and groups, including environmental, social, and economic implications for long-term sustainability.
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems.
PA Standards: Social Studies	6.1.9.B: Identify the origin of resources and analyze the impact on the production of goods and services. Analyze how unlimited wants and limited resources affect decision making. 7.1.12.A: Use geographic tools to analyze information about the interaction between people, places, and the environment.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-1R: Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.

Grades 9–12**3.1.9-12.O Life Science:** Interdependent Relationships in Ecosystems

Students who demonstrate understanding can *evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.*

Clarifying Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. - Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. Connections to Nature of Science Scientific Knowledge is Open to Revision in Light of New Evidence - Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.	Social Interactions and Group Behavior Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to cicada populations that reside in Pennsylvania, hatch periodically, and exhibit swarming behavior; and waterfowl migration that can be seen throughout Pennsylvania.

PA Career Ready Skills: Establish pro-social relationships to support self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	5.1.12.B: Employ historical examples and political philosophy to evaluate the major arguments advanced for the necessity of government.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.P Life Science:** Inheritance and Variation of Traits

Students who demonstrate understanding can ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Clarifying Statement: N/A

Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Asking Questions and Defining Problems Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Ask questions that arise from examining models or a theory to clarify relationships.	Structure and Function - All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. Inheritance of Traits - Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.I: Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. CC.3.5.11-12.I: Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
PA Core Standards and Practices: Math	CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.Q Life Science:** Inheritance and Variation of Traits

Students who demonstrate understanding can make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Clarifying Statement: Emphasis is on using data to support arguments for the way variation occurs.

Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.	Variation of Traits - In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. - Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.A: Write arguments focused on discipline-specific content.
PA Core Standards and Practices: Math	CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.R Life Science:** Inheritance and Variation of Traits

Students who demonstrate understanding can *apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.*

Clarifying Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.

Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	Variation of Traits Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.	Scale Proportion and Quantity - Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). Connections to Nature of Science Science is a Human Endeavor - Technological advances have influenced the progress of science and science has influenced advances in technology. - Science and engineering are influenced by society and society is influenced by science and engineering.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local connections to Pennsylvania plants and wildlife populations, and to invasive species such as deer, mussels, lanternfly, garlic mustard, and ginkgo plants.

PA Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.S Life Science:** Natural Selection and Evolution

Students who demonstrate understanding can *communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.*

Clarifying Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. - Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena - A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	Evidence of Common Ancestry and Diversity Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.	Patterns - Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.

Pennsylvania Context: N/A

PA Career Ready Skills: Select expressive communication strategies specific to context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12

3.1.9-12.T Life Science: Natural Selection and Evolution

Students who demonstrate understanding can *construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.*

Clarifying Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.

Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Natural Selection - Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. Adaptation - Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to genetic variations within native species such as albino squirrels, black squirrels, albino deer, Pennsylvania elk, timber rattlesnakes, river otters, and brown trout. Various Pennsylvania organisms are impacted by changing environmental conditions.

PA Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.U Life Science:** Natural Selection and Evolution

Students who demonstrate understanding can *apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.*

Clarifying Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.

Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	Natural Selection - Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. - The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. Adaptation - Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. Adaptation also means that the distribution of traits in a population can change when conditions change.	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to genetic variations within native species such as albino squirrels, black squirrels, albino deer, Pennsylvania elk, timber rattlesnakes, river otters, and brown trout.

PA Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12

3.1.9-12.V Life Science: Interdependent Relationships in Ecosystems

Students who demonstrate understanding can *create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*

Clarifying Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.	Adaptation - Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species. Biodiversity and Humans - Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. Developing Possible Solutions - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. - Both physical models and computers can be used in various ways to aid in the engineering design process. - Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local connections to agriculture, invasive species, urbanization, and resource management for maintaining biodiversity and preserving the ecosystem.

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.02.a: Read and interpret the definition of sustainability and summarize how it relates to AFNR activities.
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 2.3.A. Human-environment interactions: Learners analyze ways that humans interact with their environment and how these interactions change with technological developments. Learners determine costs and benefits to different groups in society as well as unintended consequences.
PA Core Standards: ELA	CC.3.6.9-12.D: Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
PA Core Standards and Practices: Math	CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-1R: Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.

Grades 9–12**3.1.9-12.W Life Science:** Natural Selection and Evolution

Students who demonstrate understanding can *construct an explanation based on evidence for how natural selection leads to adaptation of populations.*

Clarifying Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Adaptation Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. Adaptation also means that the distribution of traits in a population can change when conditions change.	Cause and Effect - Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.

Pennsylvania Context: N/A

PA Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
PA Standards: Social Studies	7.1.12.A: Use geographic tools to analyze information about the interaction between people, places, and the environment.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.1.9-12.X Life Science:** Natural Selection and Evolution

Students who demonstrate understanding can *evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.*

Clarifying Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	Adaptation - Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species. - Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 3.1.D. Working with flexibility, creativity, and openness: Learners engage each other in evidence-based peer review and work collaboratively and cooperatively in the spirit of open deliberation, especially in contexts that bring to the surface deeply held priorities and values.
PA Core Standards: ELA	CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	6.1.9.A: Analyze how choices are made because of scarcity.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.A Physical Science:** Structure and Properties of Matter

Students who demonstrate understanding can use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Clarifying Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.

Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.	Structure and Properties of Matter - Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. - The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. Types of Interactions Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.F. Working with models and simulations: Learners create, use, test, and evaluate models to analyze environmental questions, problems, issues, or phenomena.
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.B Physical Science:** Structure and Properties of Matter

Students who demonstrate understanding can *plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.*

Clarifying Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.

Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	Structure and Properties of Matter - The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. Types of Interactions - Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Pennsylvania Context: N/A

PA Career Ready Skills: Establish and pursue goals or post-secondary education, employment, and living within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.B. Designing investigations: Learners design investigations to explore environmental questions, problems, issues, phenomena, and models. They explain their reasoning.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-10.A: Cite specific textual evidence to support analysis of science and technical texts attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. CC.3.6.9-10.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. CC.3.6.11-12.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-1Q: Conduct research to inform intentional inventions and innovations that address specific needs and wants.

Grades 9–12**3.2.9-12.C Physical Science: Chemical Reactions**

Students who demonstrate understanding can *construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.*

Clarifying Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.

Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Structure and Properties of Matter - The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. Chemical Reactions - The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate behaviors in relation to the impact on self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.
PA Core Standards: ELA	CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.D: Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
PA Core Standards and Practices: Math	CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.D Physical Science: Chemical Reactions**

Students who demonstrate understanding can *develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.*

Clarifying Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.

Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	Structure and Properties of Matter - A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. Chemical Reactions - Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	Energy and Matter Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12

3.2.9-12.E Physical Science: Chemical Reactions

Students who demonstrate understanding can *apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.*

Clarifying Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.

Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Chemical Reactions Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-10.A: Cite specific textual evidence to support analysis of science and technical texts attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12

3.2.9-12.F Physical Science: Chemical Reactions

Students who demonstrate understanding can *refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*

Clarifying Statement: Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.

Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Chemical Reactions - In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. Optimizing the Design Solution - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.	Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze adverse situations for the purpose of identifying and selecting healthy coping skills.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR workplaces or scenarios using technology.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.
PA Core Standards: ELA	CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	6.1.9.B: Identify the origin of resources and analyze the impact on the production of goods and services. Analyze how unlimited wants and limited resources affect decision making.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-1R: Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.

Grades 9–12**3.2.9-12.G Physical Science: Chemical Reactions**

Students who demonstrate understanding can *use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.*

Clarifying Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.

Assessment Boundary: Assessment does not include complex chemical reactions.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Chemical Reactions The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	Energy and Matter - The total amount of energy and matter in closed systems is conserved. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes the universe is a vast single system in which basic laws are consistent.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.
PA Core Standards: ELA	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.HS.F.4; Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.H Physical Science:** Structure and Properties of Matter

Students who demonstrate understanding can *develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.*

Clarifying Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.

Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	Nuclear Processes Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.	Energy and Matter In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's nuclear power plants.

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.I Physical Science: Forces and Interactions**

Students who demonstrate understanding can *analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.*

Clarifying Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.

Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. - Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena - Theories and laws provide explanations in science. Laws are statements or descriptions of the relationships among observable phenomena.	Forces and Motion Newton's second law accurately predicts changes in the motion of macroscopic objects.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania amusement or theme parks and ski resorts.

PA Career Ready Skills: Evaluate how societal conventions may influence the perspectives of individuals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.E. Organizing and analyzing information: Learners organize, analyze, and display data and information from their environmental investigations for a variety of audiences and purposes.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.2.HS.D.7: Create and graph equations or inequalities to describe numbers or relationships. CC.2.2.HS.C.2: Graph and analyze functions and use their properties to make connections between the different representations. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.J Physical Science:** Forces and Interactions

Students who demonstrate understanding can *use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.*

Clarifying Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.

Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Forces and Motion Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.	Systems and System Models When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.F. Working with models and simulations: Learners create, use, test, and evaluate models to analyze environmental questions, problems, issues, or phenomena.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. CC.2.2.HS.D.7: Create and graph equations or inequalities to describe numbers or relationships.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.K Physical Science:** Forces and Interactions

Students who demonstrate understanding can *apply scientific and engineering ideas to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision.*

Clarifying Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.

Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Forces and Motion - If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. Defining and Delimiting an Engineering Problem - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. Optimizing the Design Solution - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.	Cause and Effect Systems can be designed to cause a desired effect.

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR workplaces or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 3.2.C. Planning and taking action: Learners develop action strategies and design solutions based on their research and analysis of an environmental issue. If appropriate, they implement plans that are within the scope of their rights and consistent with their individual abilities and responsibilities as members of the community.
PA Core Standards: ELA	CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-1R: Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system. STEL-7Y: Optimize a design by addressing desired qualities within criteria and constraints.

Grades 9–12**3.2.9-12.L Physical Science:** Forces and Interactions

Students who demonstrate understanding can use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

Clarifying Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.

Assessment Boundary: Assessment is limited to systems with two objects.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Types of Interactions - Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. - Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena Theories and laws provide explanations in science. Laws are statements or descriptions of the relationships among observable phenomena.		

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate behaviors in relation to the impact on self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.F. Working with models and simulations: Learners create, use, test, and evaluate models to analyze environmental questions, problems, issues, or phenomena.
PA Core Standards: ELA	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. CC.2.2.HS.D.1: Interpret the structure of expressions to represent a quantity in terms of its context. CC.2.2.HS.D.2: Write expressions in equivalent forms to solve problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.M Physical Science:** Forces and Interactions

Students who demonstrate understanding can *plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.*

Clarifying Statement: N/A

Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	Types of Interactions - Newton’s law of universal gravitation and Coulomb’s law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. - Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. Definitions of Energy “Electrical energy” may mean energy stored in a battery or energy transmitted by electric currents.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to nonsolar power plants in the Commonwealth.

PA Career Ready Skills: Establish pro-social relationships to support self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth’s physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.6.11-12.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.N Physical Science:** Structure and Properties of Matter

Students who demonstrate understanding can *communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*

Clarifying Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.

Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific and technical information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	Types of Interactions - Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. Structure and Properties of Matter - The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.	Structure and Function Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

Pennsylvania Context: N/A

PA Career Ready Skills: Select expressive communication strategies specific to context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 1.G. Drawing conclusions and developing explanations: Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-10.A: Cite specific textual evidence to support analysis of science and technical texts attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12

3.2.9-12.O Physical Science: Energy

Students who demonstrate understanding can *create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.*

Clarifying Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.

Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.	Definitions of Energy - Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. Conservation of Energy and Energy Transfer - Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. - Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. - Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g., relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. - The availability of energy limits what can occur in any system.	Systems and System Models - Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes the universe is a vast single system in which basic laws are consistent.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the various forms of power generation in Pennsylvania that convert one form of energy to another.

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.P Physical Science: Energy**

Students who demonstrate understanding can *develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).*

Clarifying Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	Definitions of Energy - Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. - At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. - These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.	Energy and Matter Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate how societal conventions may influence the perspectives of individuals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.Q Physical Science: Energy**

Students who demonstrate understanding can *design, build and refine a device that works within given constraints to convert one form of energy into another form of energy.*

Clarifying Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.

Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Definitions of Energy - At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. Energy in Chemical Processes - Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. Defining and Delimiting an Engineering Problem - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.	Energy and Matter - Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World - Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the various forms of power generation in Pennsylvania that convert one form of energy to another.

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.c: Solve problems in AFNR workplaces or scenarios using technology.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 3.1.C. Identifying alternative solutions and courses of action: Learners identify and propose environmental action plans, including design solutions, and evaluate their likely effectiveness in specific environmental, cultural/social, and economic contexts. They identify ways that these action plans and design solutions might affect different groups of people, including possible environmental justice and social equity implications. 9-12 Strand 3.1.D. Working with flexibility, creativity, and openness: Learners engage each other in evidence-based peer review and work collaboratively and cooperatively in the spirit of open deliberation, especially in contexts that bring to the surface deeply held priorities and values.
PA Core Standards: ELA	CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-1R: Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.

Grades 9–12

3.2.9-12.R Physical Science: Energy

Students who demonstrate understanding can *plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).*

Clarifying Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.

Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	Conservation of Energy and Energy Transfer - Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. - Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). Energy in Chemical Processes - Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.	Systems and System Models When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the various forms of power generation in Pennsylvania that convert one form of energy to another.

PA Career Ready Skills: Establish pro-social relationships to support self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CC.3.6.9-10.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. CC.3.6.11-12.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.S Physical Science: Energy**

Students who demonstrate understanding can *develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.*

Clarifying Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.

Assessment Boundary: Assessment is limited to systems containing two objects.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	Relationship Between Energy and Forces When two objects interacting through a field change relative position, the energy stored in the field is changed.	Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CC.3.6.9-10.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. CC.3.6.11-12.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.T Physical Science:** Waves and Electromagnetic Radiation

Students who demonstrate understanding can use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

Clarifying Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.

Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Wave Properties The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Pennsylvania Context: N/A

PA Career Ready Skills: Select expressive communication strategies specific to context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.F. Working with models and simulations: Learners create, use, test, and evaluate models to analyze environmental questions, problems, issues, or phenomena.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.2.HS.D.1: Interpret the structure of expressions to represent a quantity in terms of its context. CC.2.2.HS.D.2: Write expressions in equivalent forms to solve problems. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12

3.2.9-12.U Physical Science: Waves and Electromagnetic Radiation

Students who demonstrate understanding can *evaluate questions about the advantages of using digital transmission and storage of information.*

Clarifying Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Asking Questions and Defining Problems Asking questions and defining problems in 9–12 builds from K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.	Wave Properties Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.	Stability and Change - Systems can be designed for greater or lesser stability. Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World - Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to geographic features in Pennsylvania that limit the transmission of electromagnetic waves across the state.

PA Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 3.1.A. Identifying and investigating issues: Learners apply their research and analytical skills to systematically investigate environmental issues ranging from local issues to those that are regional or global in scope.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	6.1.9.D: Explain how incentives cause people to change their behavior in predictable ways. 6.1.12.C: Analyze the opportunity cost of decisions made by individuals, businesses, communities, and nations.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4T: Evaluate how technologies alter human health and capabilities.

Grades 9–12**3.2.9-12.V Physical Science:** Waves and Electromagnetic Radiation

Students who demonstrate understanding can *evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model and that for some situations one model is more useful than the other.*

Clarifying Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.

Assessment Boundary: Assessment does not include using quantum theory.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. - Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena - A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	Wave Properties - Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) Electromagnetic Radiation - Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.	Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Pennsylvania Context: N/A

PA Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.G. Drawing conclusions and developing explanations: Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.2.HS.D.2: Write expressions in equivalent forms to solve problems. CC.2.2.HS.D.7: Create and graph equations or inequalities to describe numbers or relationships.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.2.9-12.W Physical Science:** Waves and Electromagnetic Radiation

Students who demonstrate understanding can *evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.*

Clarifying Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.

Assessment Boundary: Assessment is limited to qualitative descriptions.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs. Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible.	Electromagnetic Radiation When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.	Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Pennsylvania Context: N/A

PA Career Ready Skills: Analyze adverse situations for the purpose of identifying and selecting healthy coping skills.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. CC.3.6.9-10.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. CC.3.6.11-12.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
PA Core Standards and Practices: Math	CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-1Q: Conduct research to inform intentional inventions and innovations that address specific needs and wants.

Grades 9–12

3.2.9-12.X Physical Science: Waves and Electromagnetic Radiation

Students who demonstrate understanding can *communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*

Clarifying Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.

Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate technical information or ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	Energy in Chemical Processes - Solar cells are human-made devices that likewise capture the sun’s energy and produce electrical energy. Wave Properties - Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. Electromagnetic Radiation - Photoelectric materials emit electrons when they absorb light of a high-enough frequency. Information Technologies and Instrumentation - Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.	Cause and Effect - Systems can be designed to cause a desired effect. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. Influence of Engineering, Technology, and Science on Society and the Natural World - Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to geographic features in Pennsylvania that limit the transmission of electromagnetic waves across the state.

PA Career Ready Skills: Select expressive communication strategies specific to context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.01.a: Research technologies used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.G. Drawing conclusions and developing explanations: Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.
PA Core Standards: ELA	CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-2X: Cite examples of the criteria and constraints of a product or system and how they affect final design.

Grades 9–12**3.3.9-12.A Earth and Space Science: Space Systems**

Students who demonstrate understanding can *develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation.*

Clarifying Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.

Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	The Universe and Its Stars - The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. Energy in Chemical Processes and Everyday Life - Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation.	Scale Proportion and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.F. Working with models and simulations: Learners create, use, test, and evaluate models to analyze environmental questions, problems, issues, or phenomena.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.2.HS.D.1: Interpret the structure of expressions to represent a quantity in terms of its context.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12

3.3.9-12.B Earth and Space Science: Space Systems

Students who demonstrate understanding can *construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.*

Clarifying Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	The Universe and Its Stars - The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. - The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. - Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. Electromagnetic Radiation - Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.	Energy and Matter - Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. - Science assumes the universe is a vast single system in which basic laws are consistent.

Pennsylvania Context: N/A

PA Career Ready Skills: Select expressive communication strategies specific to context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.G. Drawing conclusions and developing explanations: Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.3.9-12.C Earth and Space Science: Space Systems**

Students who demonstrate understanding can *communicate scientific ideas about the way stars, over their life cycle, produce elements.*

Clarifying Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.

Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	The Universe and Its Stars - The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. - Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.	Energy and Matter In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Pennsylvania Context: N/A

PA Career Ready Skills: Select expressive communication strategies specific to context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 1.G. Drawing conclusions and developing explanations: Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.
PA Core Standards: ELA	CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.3.9-12.D Earth and Space Science: Space Systems**

Students who demonstrate understanding can *use mathematical or computational representations to predict the motion of orbiting objects in the solar system.*

Clarifying Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.

Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematical and Computational Thinking Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Earth and the Solar System Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.	Scale Proportion and Quantity - Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.F. Working with models and simulations: Learners create, use, test, and evaluate models to analyze environmental questions, problems, issues, or phenomena.
PA Core Standards: ELA	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.2.HS.D.1: Interpret the structure of expressions to represent a quantity in terms of its context. CC.2.2.HS.D.7: Create and graph equations or inequalities to describe numbers or relationships.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.3.9-12.E Earth and Space Science: Weather and Climate**

Students who demonstrate understanding can *use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.*

Clarifying Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.

Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Use a model to provide mechanistic accounts of phenomena.	Earth and the Solar System - Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. Earth Materials and System - The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic Weather and Climate - The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence Science arguments are strengthened by multiple lines of evidence supporting a single explanation.		

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems. 9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	7.2.9.B: Explain the dynamics of the fundamental processes that underlie the operation of Earth's physical systems.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.3.9-12.F Earth and Space Science: History of Earth**

Students who demonstrate understanding can *evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.*

Clarifying Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust decreasing with distance away from a central ancient core of the continental plate (a result of past plate interactions).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	The History of Planet Earth - Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. Plate Tectonics and Large-Scale System Interactions - Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Nuclear Processes - Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.	Patterns Empirical evidence is needed to identify patterns.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to geoscience processes that form and result from Pennsylvania contexts such as flowing water, glacial impacts, and plate collisions.

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.G. Drawing conclusions and developing explanations: Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	7.2.9.B: Explain the dynamics of the fundamental processes that underlie the operation of Earth's physical systems. 7.2.12.A: Analyze the physical characteristics of places and regions, including the interrelationships among the components of Earth's physical systems.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.3.9-12.G Earth and Space Science: History of Earth**

Students who demonstrate understanding can *apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.*

Clarifying Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.	The History of Planet Earth - Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. Nuclear Processes - Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.	Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable.
Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena - A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. - Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory.		

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the geologic history of Pennsylvania rock strata correlated with the formation of Pennsylvania mountain ranges.

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 1.G. Drawing conclusions and developing explanations: Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. CC.3.6.9-12.A: Write arguments focused on discipline-specific content.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. CC.2.2.HS.C.2: Graph and analyze functions and use their properties to make connections between the different representations. CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables.
PA Standards: Social Studies	7.1.9.A: Explain and illustrate how geographic tools are used to organize and interpret information about people, places, and environments.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.3.9-12.H Earth and Space Science: Earth's Systems**

Students who demonstrate understanding can *analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems.*

Clarifying Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	Earth Materials and Systems - Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. Weather and Climate - The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.	Stability and Change - Feedback (negative or positive) can stabilize or destabilize a system. Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World - New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the critical importance of watersheds in Pennsylvania; investigation of impacts on local watersheds may be considered.

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems. 9-12 Strand 3.1.B. Sorting out the consequences of issues: Learners evaluate the consequences of a broad range of environmental changes, conditions, and issues on environmental quality and long-term sustainability. They identify environmental justice and social equity implications.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.B: Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CC.3.5.9-12.B: Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	7.2.9.B: Explain the dynamics of the fundamental processes that underlie the operation of Earth's physical systems.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.3.9-12.I Earth and Space Science: Earth's Systems**

Students who demonstrate understanding can *develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.*

Clarifying Statement: Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). - Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence - Science disciplines share common rules of evidence used to evaluate explanations about natural systems. - Science includes the process of coordinating patterns of evidence with current theory.	Earth Materials and Systems - Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. Plate Tectonics and Large-Scale System Interactions - The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. Wave Properties - Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet.	Energy and Matter - Energy drives the cycling of matter within and between systems. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology - Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

Pennsylvania Context: N/A

PA Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.3.9-12.J Earth and Space Science: History of Earth**

Students who demonstrate understanding can *develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.*

Clarifying Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).

Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	Earth Materials and Systems - Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. Plate Tectonics and Large-Scale System Interactions - Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust.	Stability and Change Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the fact that Pennsylvania's physiographic provinces are the result of constructive forces and destructive mechanisms.

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.01.01.a: Research and describe different types of geographic data used in AFNR systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	7.1.9.A: Explain and illustrate how geographic tools are used to organize and interpret information about people, places, and environments.
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12

3.3.9-12.K Earth and Space Science: Earth's Systems

Students who demonstrate understanding can plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

Clarifying Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	The Roles of Water in Earth's Surface Processes The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.	Structure and Function The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to how Pennsylvania's waterways dissolve, transport, and deposit sediment.

PA Career Ready Skills: Analyze adverse situations for the purpose of identifying and selecting healthy coping skills.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems. 9-12 Strand 3.1.B. Sorting out the consequences of issues: Learners evaluate the consequences of a broad range of environmental changes, conditions, and issues on environmental quality and long-term sustainability. They identify environmental justice and social equity implications.
PA Core Standards: ELA	CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
PA Core Standards and Practices: Math	CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.3.9-12.L Earth and Space Science: Earth's Systems**

Students who demonstrate understanding can *develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.*

Clarifying Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	Weather and Climate - Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. - Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.	Energy and Matter The total amount of energy and matter in closed systems is conserved.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to a local Pennsylvania farm or forest that could illustrate the cycling of carbon.

PA Career Ready Skills: Select expressive communication strategies specific to context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.3.9-12.M Earth and Space Science: Human Sustainability**

Students who demonstrate understanding can use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Clarifying Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.

Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical and/or computational representation(s) of phenomena or design solutions to describe and/or support claims and/or explanations.	Weather and Climate - Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. Global Climate Change - Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.	Systems and System Models When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to urbanization practices in Pennsylvania.

PA Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.a: Define stewardship of natural resources and distinguish how it connects to AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 2.3.A. Human-environment interactions: Learners analyze ways that humans interact with their environment and how these interactions change with technological developments. Learners determine costs and benefits to different groups in society as well as unintended consequences.
PA Core Standards: ELA	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems.
PA Standards: Social Studies	7.4.12.B: Analyze the global effects of human activity on the physical systems.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-4S: Develop a solution to a technological problem that has the least negative environmental and social impact.

Grades 9–12

3.3.9-12.N Earth and Space Science: Earth's Systems

Students who demonstrate understanding can *construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.*

Clarifying Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.

Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Construct an oral and written argument or counter-arguments based on data and evidence.	Weather and Climate - Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. Biogeology - The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it.	Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable.

Pennsylvania Context: N/A

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.6.9-12.A: Write arguments focused on discipline-specific content.
PA Core Standards and Practices: Math	N/A
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12

3.3.9-12.O Earth and Space Science: Human Sustainability

Students who demonstrate understanding can *construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.*

Clarifying Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Natural Resources - Resource availability has guided the development of human society. Natural Hazards - Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations.	Cause and Effect - Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. <i>Connections to Engineering, Technology, and Applications of Science</i> Influence of Science, Engineering, and Technology on Society and the Natural World - Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate how societal conventions may influence the perspectives of individuals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.b: Analyze available practices to steward natural resources in AFNR systems (e.g., wildlife and land conservation, soil and water practices, ecosystem management, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.3.A. Human-environment interactions: Learners analyze ways that humans interact with their environment and how these interactions change with technological developments. Learners determine costs and benefits to different groups in society as well as unintended consequences. 9-12 Strand 2.3.B. Resource distribution and consumption: Learners analyze ways that the perceived value and use of natural resources change over time and vary under different economic, political, social, and technological systems.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	6.1.9.B: Identify the origin of resources and analyze the impact on the production of goods and services. Analyze how unlimited wants and limited resources affect decision making.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4P: Evaluate ways that technology can impact individuals, society, and the environment.

Grades 9–12

3.3.9-12.P Earth and Space Science: Human Sustainability

Students who demonstrate understanding can *evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*

Clarifying Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations).	Natural Resources - All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. Developing Possible Solutions - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World - Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. Analysis of costs and benefits is a critical aspect of decisions about technology. Connections to Nature of Science Science Addresses Questions About the Natural and Material World - Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. - Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. - Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to watersheds in Pennsylvania and the sustainable use of Pennsylvania's agricultural and energy resources.

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.a: Define stewardship of natural resources and distinguish how it connects to AFNR systems.
Science, Environmental Literacy and Sustainability (NAEEE)	9-12 Strand 2.3.B. Resource distribution and consumption: Learners analyze ways that the perceived value and use of natural resources change over time and vary under different economic, political, social, and technological systems. 9-12 Strand 3.1.C. Identifying alternative solutions and courses of action: Learners identify and propose environmental action plans, including design solutions, and evaluate their likely effectiveness in specific environmental, cultural/social, and economic contexts. They identify ways that these action plans and design solutions might affect different groups of people, including possible environmental justice and social equity implications.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
PA Standards: Social Studies	6.2.9.B: Explain how competition between buyers and sellers affects price. 6.1.12.C: Analyze the opportunity cost of decisions made by individuals, businesses, communities, and nations.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-7W: Determine the best approach by evaluating the purpose of the design.

Grades 9–12**3.3.9-12.Q Earth and Space Science: Human Sustainability**

Students who demonstrate understanding can *create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.*

Clarifying Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.

Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.	Human Impacts on Earth Systems The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.	Stability and Change - Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World - Modern civilization depends on major technological systems. - New technologies can have deep impacts on society and the environment, including some that were not anticipated. Connections to Nature of Science Science is a Human Endeavor - Science is a result of human endeavors, imagination, and creativity.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the relationships among Pennsylvania's energy resources, mining, watersheds, agricultural practices, and biodiversity.

PA Career Ready Skills: Evaluate how societal conventions may influence the perspectives of individuals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.02.b: Analyze and assess sustainability practices that can be applied in AFNR systems (e.g., energy efficiency, recycle/re-use/repurpose, green resources, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 2.3.A. Human-environment interactions: Learners analyze ways that humans interact with their environment and how these interactions change with technological developments. Learners determine costs and benefits to different groups in society as well as unintended consequences.
PA Core Standards: ELA	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics.
PA Standards: Social Studies	6.1.9.B: Identify the origin of resources and analyze the impact on the production of goods and services. Analyze how unlimited wants and limited resources affect decision making.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-4P: Evaluate ways that technology can impact individuals, society, and the environment.

Grades 9–12**3.3.9-12.R Earth and Space Science:** Human Sustainability

Students who demonstrate understanding can *evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

Clarifying Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Human Impacts on Earth Systems - Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. Developing Possible Solutions - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	Stability and Change - Feedback (negative or positive) can stabilize or destabilize a system. Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World - Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. Analysis of costs and benefits is a critical aspect of decisions about technology.

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 2.3.A. Human-environment interactions: Learners analyze ways that humans interact with their environment and how these interactions change with technological developments. Learners determine costs and benefits to different groups in society as well as unintended consequences.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	7.4.12.B: Analyze the global effects of human activity on the physical systems.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-7Y: Optimize a design by addressing desired qualities within criteria and constraints.

Grades 9–12**3.3.9-12.S Earth and Space Science:** Weather and Climate

Students who demonstrate understanding can *analyze geoscience data and the results from global climate models to make an evidence based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.*

Clarifying Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).

Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. - Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. Connections to Nature of Science Scientific Investigations Use a Variety of Methods - Science investigations use diverse methods and do not always use the same set of procedures to obtain data. - New technologies advance scientific knowledge. Scientific Knowledge Is Based on Empirical Evidence - Science arguments are strengthened by multiple lines of evidence supporting a single explanation.	Global Climate Change Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.	Stability and Change Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's latitude, altitude, and geography.

PA Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.01.01.a: Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.3.A. Human-environment interactions: Learners analyze ways that humans interact with their environment and how these interactions change with technological developments. Learners determine costs and benefits to different groups in society as well as unintended consequences. 9-12 Strand 3.1.B. Sorting out the consequences of issues: Learners evaluate the consequences of a broad range of environmental changes, conditions, and issues on environmental quality and long-term sustainability. They identify environmental justice and social equity implications.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.B: Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CC.3.5.9-12.B: Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. 3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
PA Core Standards and Practices: Math	CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	7.2.9.B: Explain the dynamics of the fundamental processes that underlie the operation of Earth's physical systems.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.

Grades 9–12**3.4.9-12.A Environmental Literacy and Sustainability:** Agricultural and Environmental Systems and Resources

Students who demonstrate understanding can *analyze and interpret how issues, trends, technologies, and policies impact agricultural, food, and environmental systems and resources.*

Clarifying Statement: Emphasis is on the cause-and-effect relationship, whether it be positive or negative.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	Ecosystem Dynamics, Functioning, and Resilience - A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. Natural Resources - Resource availability has guided the development of human society. Human Impacts on Earth Systems - The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.	Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local connections to Pennsylvania agriculture, aquaculture, urban agriculture businesses, manufacturing, recreational businesses, electricity and power, mining, biotechnology, forest products, and transportation industries.

PA Career Ready Skills: Evaluate how societal conventions may influence the perspectives of individuals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.03.01.a: Summarize public policies affecting AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 2.2.A. Individuals, groups, and societies: Learners observe and describe ways that individual and group action affects the environment, and how each can work to promote the common good. They analyze differing beliefs and values within the same community and the larger society and explain how sustainable solutions rely on reconciling diverse perspectives.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	6.1.9.B: Identify the origin of resources and analyze the impact on the production of goods and services. Analyze how unlimited wants and limited resources affect decision making. 6.3.C.A: Evaluate the costs and benefits of government decisions to provide public goods and services.
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-4P: Evaluate ways that technology can impact individuals, society, and the environment.

Grades 9–12**3.4.9-12.B Environmental Literacy and Sustainability:** Agricultural and Environmental Systems and Resources

Students who demonstrate understanding can *apply research and analytical skills to evaluate the conditions and motivations that lead to conflict, cooperation, and change among individuals, groups, and nations.*

Clarifying Statement: Emphasis is on the effects of agriculture and natural resource availability, quality, control, and utilization.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.	Ecosystem Dynamics, Functioning, and Resilience - A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. Natural Resources - Resource availability has guided the development of human society. Human Impacts on Earth Systems - The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.	Connections to Nature of Science Science Addresses Questions About the Natural and Material World - Not all questions can be answered by science. - Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. - Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.02.b: Assess how people within societies on local, state, national and global levels interact with AFNR systems on daily, monthly or yearly basis.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 3.1.D. Working with flexibility, creativity, and openness: Learners engage each other in evidence-based peer review and work collaboratively and cooperatively in the spirit of open deliberation, especially in contexts that bring to the surface deeply held priorities and values.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research. CC.1.5.11-12.D: Present information, findings, and supporting evidence, conveying a clear and distinct perspective; organization, development, substance, and style are appropriate to purpose, audience, and task.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	6.1.9.D: Explain how incentives cause people to change their behavior in predictable ways. 5.1.W.B: Analyze how conflict and cooperation among groups and organizations have influenced the history and development of the world. (Reference History Standards 8.3.9.D.)
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-6H: Evaluate how technology has been a powerful force in reshaping social, cultural, political, and economic landscapes throughout history.

Grades 9–12**3.4.9-12.C Environmental Literacy and Sustainability:** Agricultural and Environmental Systems and Resources

Students who demonstrate understanding can *analyze and interpret how issues, trends, technologies, and policies impact watersheds and water resources.*

Clarifying Statement: Emphasis is on the cause-and-effect relationship, whether it be positive or negative.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	Ecosystem Dynamics, Functioning, and Resilience - Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. Biodiversity and Humans - Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). - Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. Natural Resources - Resource availability has guided the development of human society.	Cause and Effect - Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Stability and Change - Feedback (negative or positive) can stabilize or destabilize a system.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local connections to Pennsylvania agriculture, aquaculture, urban agriculture businesses manufacturing, recreational businesses, electricity and power, mining, biotechnology, forest products, and transportation industries.

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.06.02.02.a: Examine and summarize changes that happen in AFNR systems on a national and global level (e.g., using less irrigation water, reduction of inputs, etc.).
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.2.A. Individuals, groups, and societies: Learners observe and describe ways that individual and group action affects the environment, and how each can work to promote the common good. They analyze differing beliefs and values within the same community and the larger society and explain how sustainable solutions rely on reconciling diverse perspectives.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	7.4.12.B: Analyze the global effects of human activity on the physical systems.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4P: Evaluate ways that technology can impact individuals, society, and the environment.

Grades 9–12

3.4.9-12.D Environmental Literacy and Sustainability: Environmental Literacy Skills

Students who demonstrate understanding can *apply research and analytical skills to systematically investigate environmental issues ranging from local issues to those that are regional or global in scope.*

Clarifying Statement: Emphasis is on students' ability to articulate assumptions, goals, priorities, and values that underlie perspectives on environmental issues.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.	Ecosystem Dynamics, Functioning, and Resilience - A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. Biodiversity and Humans - Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). - Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. Human Impacts on Earth Systems - The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.02.a: Define and summarize societies on local, state, national and global levels and describe how they relate to AFNR systems.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.C. Collecting information: Learners use established protocols to locate and collect information for environmental investigations of many types. They use increasingly sophisticated methods and technology to access, gather, store, and display the information they collect.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	7.4.12.B: Analyze the global effects of human activity on the physical systems.
Educational Technology (ISTE)	1.1. Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.
Technology and Engineering (ITEEA)	STEL-4P: Evaluate ways that technology can impact individuals, society, and the environment.

Grades 9–12**3.4.9-12.E Environmental Literacy and Sustainability:** Environmental Literacy Skills

Students who demonstrate understanding can *plan and conduct an investigation utilizing environmental data about a local environmental issue.*

Clarifying Statement: Emphasis is on student-collected data from sources such as outdoor field experiences, media coverage, data mining, and so on.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Planning and Carrying Out Investigations Planning and carrying out investigations in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	Ecosystem Dynamics, Functioning, and Resilience - Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. Biodiversity and Humans - Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). - Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. Human Impacts on Earth Systems - The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.	Connections to Nature of Science Science Is a Way of Knowing Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to local colleges and universities, local nature centers, Pennsylvania Conservation Districts, and science museums and centers.

PA Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.B. Designing investigations: Learners design investigations to explore environmental questions, problems, issues, phenomena, and models. They explain their reasoning.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	7.4.12.B: Analyze the global effects of human activity on the physical systems.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-4P: Evaluate ways that technology can impact individuals, society, and the environment.

Grades 9–12**3.4.9-12.F Environmental Literacy and Sustainability:** Environmental Literacy Skills

Students who demonstrate understanding can *evaluate and communicate the effect of integrated pest management practices on indoor and outdoor environments.*

Clarifying Statement: Emphasis is on assessing and communicating the effectiveness and impact of approaches to integrated pest management. Examples may include biological (e.g., managing indoor air quality), cultural (e.g., planting locally pest-resistant crops or crop rotation), mechanical (e.g., trapping pests), and chemical (e.g., cleaning surfaces in schools) treatments of invasives; materials and procedures for cleaning surfaces and air in schools; and maintaining or promoting biodiversity.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific and technical information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	Human Impacts on Earth Systems - The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. Developing Possible Solutions - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania farms (agriculture, aquaculture, urban), businesses, and industries such as biotechnology.

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.03.01.02.a: Summarize the importance of safety, health and environmental management in the workplace.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.G. Drawing conclusions and developing explanations: Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	7.4.12.B: Analyze the global effects of human activity on the physical systems.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4P: Evaluate ways that technology can impact individuals, society, and the environment.

Grades 9–12**3.4.9-12.G Environmental Literacy and Sustainability:** Sustainability and Stewardship

Students who demonstrate understanding can *analyze and evaluate how best resource management practices and environmental laws achieve sustainability of natural resources.*

Clarifying Statement: Emphasis is on assessing the outcomes of best management practices (e.g., stormwater, forest, land use, wildlife, and waste management) and environmental laws (i.e., international, federal, state, and local jurisdictions).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations).	Human Impacts on Earth Systems - The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. Developing Possible Solutions - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	Stability and Change - Feedback (negative or positive) can stabilize or destabilize a system. Cause and Effect - Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania-specific laws, policies, regulations, and agreements, such as the Pennsylvania Environmental Plan, Pennsylvania Environmental Rights Amendment, and Chesapeake Bay Agreement; and Pennsylvania agencies and departments such as the Department of Environmental Protection, Department of Conservation and Natural Resources, Bureau of Forestry, Commission for Agricultural Education, Fish and Boat Commission, and Game Commission.

PA Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision-making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.02.c: Evaluate sustainability policies and plans and prepare summary of potential improvements for AFNR businesses or organizations.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.G. Drawing conclusions and developing explanations: Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	6.1.9.B: Identify the origin of resources and analyze the impact on the production of goods and services. Analyze how unlimited wants and limited resources affect decision making.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4P: Evaluate ways that technology can impact individuals, society, and the environment.

Grades 9–12**3.4.9-12.H Environmental Literacy and Sustainability:** Sustainability and Stewardship

Students who demonstrate understanding can *design and evaluate solutions in which individuals and societies can promote stewardship in environmental quality and community well-being.*

Clarifying Statement: Examples of design solutions could include theoretical or tangible plans, as well as implementing project actions.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Human Impacts on Earth Systems - The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. Developing Possible Solutions - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	Connections to Nature of Science Science Addresses Questions About the Natural and Material World - Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. - Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Environmental Justice Area designations, Environmental Health Indicators, local nature centers, Pennsylvania Conservation Districts, and science museums and centers.

PA Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 3.1.A. Identifying and investigating issues: Learners apply their research and analytical skills to systematically investigate environmental issues ranging from local issues to those that are regional or global in scope.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problems. CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
PA Standards: Social Studies	6.1.9.B: Identify the origin of resources and analyze the impact on the production of goods and services. Analyze how unlimited wants and limited resources affect decision making.
Educational Technology (ISTE)	1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
Technology and Engineering (ITEEA)	STEL-7Z: Apply principles of human-centered design.

Grades 9–12**3.4.9-12.I Environmental Literacy and Sustainability:** Sustainability and Stewardship

Students who demonstrate understanding can *analyze and interpret data on a regional environmental condition and its implications on environmental justice and social equity.*

Clarifying Statement: Emphasis is on formulating a conclusion supported by data. Interpretation could be constructed using primary and secondary sources. Examples include both current and historical conditions due to systemic inequalities, including but not limited to human health impacted by Superfund sites, air quality, urban heat islands, acid mine drainage, access to green space, and water quality.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	Ecosystem Dynamics, Functioning, and Resilience - Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. Human Impacts on Earth Systems - The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.	Cause and Effect - Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Connections to Nature of Science Science Addresses Questions About the Natural and Material World - Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Environmental Justice Area designations and Environmental Health Indicators.

PA Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.01.01.b: Analyze and summarize AFNR issues and their impact on local, state, national and global levels.
Science, Environmental Literacy and Sustainability (NAAEE)	9-12 Strand 1.E. Organizing and analyzing information: Learners organize, analyze, and display data and information from their environmental investigations for a variety of audiences and purposes.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	7.4.12.B: Analyze the global effects of human activity on the physical systems.
Educational Technology (ISTE)	1.3. Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
Technology and Engineering (ITEEA)	STEL-4P: Evaluate ways that technology can impact individuals, society, and the environment.

Grades 9–12**3.5.9-12.A Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.

Clarifying Statement: Examples of such techniques include flow charts, drawings, graphics, symbols, spreadsheets, graphs, time charts, and web pages. The audiences can be peers, teachers, local community and business members, and the global community.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	Developing Possible Solutions - Both physical models and computers can be used in various ways to aid in the engineering design process. - Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.	Communication Clearly conveys ideas in constructive ways, including through written and oral communication and via mathematical and physical models.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Select expressive communication strategies specific to context.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.B Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *critically assess and evaluate a technology that minimizes resource use and resulting waste to achieve a goal.*

Clarifying Statement: By focusing on a “wicked problem”—one that is complex, has multiple possible solutions, and requires consideration of various perspectives—students can be challenged to go through a process of problem finding/defining, investigation, and design to find technological solutions that are more beneficial for society and the environment. VUCA problems—ones that are volatile, uncertain, complex, and ambiguous—challenge students to actively engage in the engineering design process to find technological solutions that are beneficial to society and minimize negative environmental impact and non-consumable by-products.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	Critical Thinking Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's manufacturing.

Pennsylvania Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.9-12.R: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Grades 9–12**3.5.9-12.C Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *develop a solution to a technological problem that has the least negative environmental and social impact.*

Clarifying Statement: Students can be challenged to engage in problem identification, analysis, investigation, and design to find technological solutions that improve people's living conditions or that improve the well-being of individuals or members of a group.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.	Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	Attention to Ethics Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's hydroelectric power plants.

Pennsylvania Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.D Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *critique whether existing or proposed technologies use resources sustainably.*

Clarifying Statement: By applying the evaluative tools described above, students can investigate ways that resources used to create and operate a given technology can be improved to enhance the sustainability of the technology. For example, they could evaluate how students are currently transported to and from school and devise ways to reduce fuel use. Strategies could include promoting bike riding by installing covered bike racks, re-routing vehicles to avoid long wait times, shifting school bus schedules to prevent extended idling times, and so on.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.	Defining and Delimiting an Engineering Problem Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.	Attention to Ethics Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's food production and packaging industries.

Pennsylvania Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.9-12.Q: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

Grades 9–12**3.5.9-12.E Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can evaluate how technology and engineering advancements alter human health and capabilities.

Clarifying Statement: Evaluative tools can be used to examine existing or proposed technologies to assess their positive and negative effects on humans. For example, CRISPR-Cas9 technology has been hailed as a tool for modifying human genetic material to reduce the risk of inherited disease. At the same time, there are medical and ethical concerns surrounding application of this technology to humans.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	Ethics, Equity, and Responsibility Disparities in the technologies available to different groups of people have consequences for public health and prosperity, but deciding whether to introduce a new technology should consider local resources and the role of culture in acceptance of the new technology.	Critical Thinking Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's biomedical research institutions.

Pennsylvania Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.7: Look for and make use of structure.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.F Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can evaluate a technological innovation that arose from a specific society's unique need or want.

Clarifying Statement: As engineers modify technological systems, materials are often chosen based on local environmental factors, locally available materials, and cost. Modes of transportation differ depending upon population density, availability, safety, speed, geography, and cost. Energy sources are chosen based on considerations such as proximity to source, cost-effectiveness, and environmental impact.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.	Interaction of Technology and Humans The decision to develop a new technology is influenced by societal opinions and demands. These driving forces differ from culture to culture.	Optimism Shows persistence in addressing technological problems and finding solutions to those problems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's manufacturing businesses and industries.

Pennsylvania Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.G Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can evaluate a technological innovation that was met with societal resistance impacting its development.

Clarifying Statement: Throughout history, societies have made moral, ethical, and political decisions impacting the development of technological solutions and innovations. Sometimes those decisions are controversial and multifaceted. Societies differ in their norms and methods for resolving the problems that arise when conflicting values preclude consensus. For example, Germany made the decision to phase out all use of nuclear power due to public opposition to this energy source.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.	Critical Thinking Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Evaluate how societal conventions may influence the perspectives of individuals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.7: Look for and make use of structure.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.H Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can evaluate ways that technology and engineering can impact individuals, society, and the environment.

Clarifying Statement: A variety of approaches and resources can be used by students when asked to evaluate given technologies. These include technology assessment, cost-benefit analysis, risk assessment, environmental impact analysis, and case studies, among others. By applying evaluative techniques, students can analyze the relationships between resources and technology to improve sustainability efforts. This process should be accompanied by an understanding of the importance of evaluating technologies in a holistic manner.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.	Interaction of Technology and Humans Analyze cultural, social, economic, or political changes (separately or together) that may be triggered by the transfer of a specific technology from one society to another. Include both anticipated and unanticipated effects.	Attention to Ethics Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's wind farms.

Pennsylvania Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others. MP.7: Look for and make use of structure.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.I (ETS) Technology and Engineering:** Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can *evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.*

Clarifying Statement: When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	Critical Thinking Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. CC.3.5.9-10.I: Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. CC.3.5.11-12.I: Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.J Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *synthesize data and analyze trends to make decisions about technological products, systems, or processes.*

Clarifying Statement: Deductive thinking and synthesis techniques can assist in this process. Students should consider historical events, global trends, and economic factors, and they should evaluate and consider how to manage the risks incurred by technological development.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Apply techniques of algebra and functions to represent and solve scientific and engineering problems.	Developing Possible Solutions When evaluating solutions, it is important to consider a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	Critical Thinking Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.7: Look for and make use of structure.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.K (ETS) Technology and Engineering:** Applying, Maintaining, and Assessing Technological Products and Systems

Students who demonstrate understanding can use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Clarifying Statement: Both physical models and computers can be used in various ways to aid in the engineering design process.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.	Developing Possible Solutions - Both physical models and computers can be used in various ways to aid in the engineering design process. - Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.	Critical Thinking Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.L Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *interpret laws, regulations, policies, and other factors that impact the development and use of technology.*

Clarifying Statement: Laws, regulations, and policies shape the development and use of technology. Students should understand, in increasingly sophisticated ways, how technology assessment impacts policy development.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.	Communication Clearly conveys ideas in constructive ways, including through written and oral communication and via mathematical and physical models.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.M Technology and Engineering:** Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

Students who demonstrate understanding can *develop a device or system for the marketplace.*

Clarifying Statement: Research on specific topics of interest to the government or business and industry can provide more information on a subject, and, in many cases, can provide information needed to create an invention or innovation. R&D helps to prepare a product or system for final production. Product development of this type frequently requires sustained effort from teams of people having diverse backgrounds.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Engineering Design Engineering design is a complicated process in which creative steps are embedded in content knowledge and research on the challenge. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps may involve redesigning for optimization.	Making and Doing Demonstrates the ability to regulate and improve making and doing skills.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.N Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can *analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems.*

Clarifying Statement: High school students can benefit from examining relationships to technology in other cultures, such as the access (or lack of access) to technologies in specific cultures. For example, people in many locations around the world lack ready access to clean water. Strategies to address this problem will vary according to the resources and circumstances of a given location.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Engineering Design Meet a sophisticated design challenge by identifying criteria and constraints, predicting how these will affect the solution, researching and generating ideas, and using trade-offs to balance competing values in selecting the best solution.	Critical Thinking Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's graphic communication companies.

Pennsylvania Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.O Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can *apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality.*

Clarifying Statement: For many consumer products, federal and state laws require safety information. Tools are used by students for diagnosis, adjustments, and repair. Monitoring the operation, adjusting the parts, and regular maintenance of a system are part of keeping systems in good working order and maintaining safety.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Optimizing the Design Solution - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. Maintenance and Troubleshooting - Analyze a complicated system to identify ways that it might fail in the future. Identify the most likely failure points and recommend safeguards to avoid future failures.	Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.P Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can apply a broad range of design skills to a design thinking process.

Clarifying Statement: Students engage in meaningful discourse about the essential skills they have applied when engaged in designing, constructing, and implementing a solution. These include creativity, collaboration, resourcefulness, ideation, learning through failure, and many other essential skills of design.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Know and Use a Deliberate Design Process Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.	Making and Doing Demonstrates the ability to regulate and improve making and doing skills.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Establish and pursue goals or post-secondary education, employment, and living within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.Q Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can *implement and critique principles, elements, and factors of design.*

Clarifying Statement: Students independently select, evaluate, and implement principles, elements, and other factors to improve their designs. The principles of design include balance, rhythm, pattern, emphasis, contrast, unity, and movement. The elements of design include line, shape, space, value, form, texture, and color. Additional design factors that can be applied to physical objects include ergonomics, energy efficiency, reliability, durability, safety, ease of manufacture, and aesthetics.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Developing Possible Solutions When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.	Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes. Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Establish pro-social relationships to support self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.R Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can use a design thinking process to design an appropriate technology for use in a different culture.

Clarifying Statement: High school students can benefit from examining relationships to technology in other cultures, such as the access (or lack of access) to technologies in specific cultures. For example, people in many locations around the world lack ready access to clean water. Strategies to address this problem will vary according to the resources and circumstances of a given location.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Interaction of Technology and Humans The decision to develop a new technology is influenced by societal opinions and demands. These driving forces differ from culture to culture.	Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. Attention to Ethics - Assess technological products, systems, and processes through critical analysis of their impacts and outcomes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's academic and research institutions.

Pennsylvania Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.S Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can *conduct research to inform intentional inventions and innovations that address specific needs and wants.*

Clarifying Statement: Years of research led to the design and development of laser systems used in atmospheric studies and other applications (LiDAR or LADAR). This same type of laser system was then modified and reapplied to treat the buildup of plaque in the arteries through laser angioplasty (i.e., surgical repair of a blood vessel such as an artery).

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.	Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.	Critical Thinking Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.T (ETS) Technology and Engineering:** Design Thinking in Technology & Engineering Education

Students who demonstrate understanding can *analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.*

Clarifying Statement: Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Analyze complex real-world problems by specifying criteria and constraints for successful solutions.	Defining and Delimiting Engineering Problems - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. - Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.	Critical Thinking Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Evaluate consequences from a personal and civic perspective to inform decision making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. CC.3.5.9-10.I: Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. CC.3.5.11-12.I: Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.U Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can evaluate and define the purpose of a design.

Clarifying Statement: In order to move forward with the best solution, it is often necessary to determine a design that best fits a number of measures such as trade-offs, resources, criteria, constraints, function, form, etc. A product must be a balance of these measures to best fit the intended use and audience.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.	Engineering Design Meet a sophisticated design challenge by identifying criteria and constraints, predicting how these will affect the solution, researching and generating ideas, and using trade-offs to balance competing values in selecting the best solution.	Communication Clearly conveys ideas in constructive ways, including through written and oral communication and via mathematical and physical models.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others. MP.4: Model with mathematics.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.V Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can apply principles of human-centered design.

Clarifying Statement: Students consider the relationship between humans and the designed environment while designing, constructing, and implementing a solution. Students will synthesize their understanding of human-centered design through critical evaluation of design decisions and their appropriateness for the intended users.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.	Creativity - Elaborates and articulates novel ideas and aesthetics. Attention to Ethics - Assess technological products, systems, and processes through critical analysis of their impacts and outcomes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.W Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can optimize a design by addressing desired qualities within criteria and constraints while considering trade-offs.

Clarifying Statement: Students evaluate criteria and constraints in the technology and engineering design process to select optimal approaches for their design solutions. Students at this level should be able to articulate a rationale (e.g., design matrix) for their decisions in the design, construction, and implementation of their solution.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.	Optimism Shows persistence in addressing technological problems and finding solutions to those problems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's energy production plants.

Pennsylvania Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.X Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can *implement the best possible solution to a design using an explicit process.*

Clarifying Statement: Students design within provided criteria and constraints and recognize trade-offs associated with optimization.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Engineering Design - Meet a sophisticated design challenge by identifying criteria and constraints, predicting how these will affect the solution, researching and generating ideas, and using trade-offs to balance competing values in selecting the best solution. Develop and Test Prototypes - Students develop, test and refine prototypes as part of a cyclical design process.	Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to the Pennsylvania's food production industries.

Pennsylvania Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.Y (ETS) Technology and Engineering:** Design Thinking in Technology & Engineering Education

Students who demonstrate understanding can *design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.*

Clarifying Statement: Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.	Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system. Making & Doing - Demonstrates the ability to regulate and improve making and doing skills.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Establish and pursue goals or post-secondary education, employment, and living within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	N/A
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.Z Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can *recognize and explain how their community and the world around them informs technological development and engineering design.*

Clarifying Statement: Technological developments are best achieved through experiences and interactions within a given context. For example, design of buildings should take into account local conditions including soil type, wind, and snow loads, and should also match local building codes and building styles.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.	Build Knowledge Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.	Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes. Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's manufacturing businesses and industry.

Pennsylvania Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.AA Technology and Engineering:** Design Thinking in Technology and Engineering Education

Students who demonstrate understanding can safely apply an appropriate range of making skills to a design thinking process.

Clarifying Statement: Students independently identify and safely use appropriate tools and processes to complete a design making task. Students recognize their own knowledge and skill gaps, pursue opportunities to develop necessary skills, and become more confident and competent in making.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Developing Possible Solutions - Both physical models and computers can be used in various ways to aid in the engineering design process. Develop and Test Prototypes - Students develop, test and refine prototypes as part of a cyclical design process.	Making and Doing Demonstrates the ability to regulate and improve making and doing skills.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Establish pro-social relationships to support self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.BB Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *assess how similarities and differences among scientific, technological, engineering, and mathematical knowledge and skills contributed to the design of a product or system.*

Clarifying Statement: Developing and improving products or systems require scientific, engineering, and technical expertise. Articulating how knowledge and skills from each contributed or will contribute to a product or system is a necessary component of innovation and design. One way this can be accomplished is by evaluating a completed engineering design task and identifying the elements from other academic disciplines that contributed to the completion of the task.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	Nature of Technology Engineers use science, mathematics, and other disciplines to improve technology, while scientists use tools devised by engineers to advance knowledge in their disciplines. This interaction has deepened over the past century.	Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Explain how you situate yourself in a diverse community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.CC Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *analyze how technology transfer occurs when a user applies an existing innovation developed for one function for a different purpose.*

Clarifying Statement: For example, aerospace composite materials were used to design an advanced, lightweight, and easy-to-maneuver wheelchair. Similarly, memory foam was originally invented as a means of improving safety in aircraft seating. Students can engage in passive research related to this standard as well as actively engaging in it through tasks such as conducting strength testing with novel building materials.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Engaging in Argument From Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence.	Interaction of Technology and Humans Analyze cultural, social, economic, or political changes (separately or together) that may be triggered by the transfer of a specific technology from one society to another. Include both anticipated and unanticipated effects.	Critical Thinking Uses evidence to better understand and solve problems in technology and engineering including applying computational thinking.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's inventors and inventions.

Pennsylvania Career Ready Skills: Evaluate behaviors in relation to the impact on self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.2.9-12.Q: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Grades 9–12**3.5.9-12.DD Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.*

Clarifying Statement: Designing, maintaining, and improving products or systems often require unique knowledge and skills. Technologically and engineering literate citizens are capable of synthesizing knowledge from science, mathematics, and other disciplines to design, construct, and execute a plan to solve a system's design problem.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.	Nature of Technology Engineers use science, mathematics, and other disciplines to improve technology, while scientists use tools devised by engineers to advance knowledge in their disciplines. This interaction has deepened over the past century.	Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Establish and pursue goals or post-secondary education, employment, and living within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12

3.5.9-12.EE Technology and Engineering: Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can *connect technological and engineering progress to the advancement of other areas of knowledge and vice versa.*

Clarifying Statement: For instance, cloud data storage aided the connectivity of physical devices, known as the Internet of Things (IoT). This advancement has enabled real-time mathematical, economic, medical, and other applications of data collection, analysis, and production. These advancements in turn are being applied to a multitude of areas, including the emerging field of “Smart Highways,” infrastructure integrated with sensors to collect data on road conditions and weather to better aid in the decision-making process of road crews and local authorities.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	Defining and Delimiting Engineering Problems - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. Nature of Technology - Advances in science have been applied by engineers to design new products, processes, and systems, while improvements in technology have enabled breakthroughs in scientific knowledge.	Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system. Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvanian inventors and inventions.

Pennsylvania Career Ready Skills: Establish and pursue goals or post-secondary education, employment, and living within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.7: Look for and make use of structure.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.FF Technology and Engineering:** Integration of Knowledge, Technologies, and Practices

Students who demonstrate understanding can evaluate how technology enhances opportunities for new products and services through globalization.

Clarifying Statement: Developing countries have in many cases bypassed telephone landlines in adopting cellular technology, which has been used not just for communication but also to complete a variety of other tasks, such as banking. This concept is referred to as late-comer advantage. The exponential growth curve of technology has led to innovations and advancements once thought unattainable. Advancements and cost reduction of technologies such as rapid prototyping, desktop CNC, and microcontrollers have provided opportunities for new and innovative product ideas.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.	Engineering Design Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	Optimism Shows persistence in addressing technological problems and finding solutions to those problems.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Establish pro-social relationships to support self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.3: Construct viable arguments and critique the reasoning of others.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.GG Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can evaluate how technology and engineering have been powerful forces in reshaping the social, cultural, political, and economic landscapes throughout history.

Clarifying Statement: Communication, agriculture, and transportation, for example, have evolved out of the political, economic, and social interests and values of the times.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	Defining & Delimiting Engineering Problems Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.	Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's manufacturing businesses and industries.

Pennsylvania Career Ready Skills: Evaluate how societal conventions may influence the perspectives of individuals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.9-12.O: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Grades 9–12

3.5.9-12.HH Technology and Engineering: Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *analyze how the Industrial Revolution resulted in the development of mass production, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time.*

Clarifying Statement: Major developments of this period included the continuous-process flour mill, power loom and pattern-weaving loom, steam engine, electric motor, gasoline and diesel engines, vulcanized rubber, airplane, telegraph, telephone, radio, and television. The concepts of Eli Whitney's interchangeable parts and Henry Ford's movable conveyor added to advances in the production of goods. Extended free time was possible for some people as a result of increased efficiency and updated labor laws, and eventually led to more widespread access to education.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	Interaction of Technology and Humans Changes caused by the introduction and use of a new technology can range from gradual to rapid and from subtle to obvious, and can change over time. These changes may vary from society to society as a result of differences in a society's economy, politics, and culture.	Systems Thinking Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's coal, oil, and natural gas industries.

Pennsylvania Career Ready Skills: Evaluate how societal conventions may influence the perspectives of individuals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.9-12.O: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Grades 9–12**3.5.9-12.II Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *investigate the widespread changes that have resulted from the Information Age, which has placed emphasis on the processing and exchange of information.*

Clarifying Statement: The development of binary language, transistors, microchips, and an electronic numerical integrator and calculator (ENIAC) led to an explosion of computers, calculators, and communication processes to quickly move information from place to place. Holography, cybernetics, xerographic copying, the breeder reactor, the hydrogen bomb, the lunar module, communication satellites, prefabrication, and gene editing have all been major developments during this time period.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.	Effects of Technology on the World of Information and Knowledge Give examples to illustrate the effects on society of the recording, distribution, and access to information and knowledge that have occurred in history, and discuss the effects of those revolutions on societal change.	Systems Thinking Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Advocate for oneself in education, employment, and within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.9-12.O: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Grades 9–12**3.5.9-12.JJ Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *identify and explain how the evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools, materials, and processes.*

Clarifying Statement: The Stone Age started with the development of stone tools used for hunting, cutting, and pounding vegetables and meat and progressed to the harnessing of fire for heating, cooking, and protection. The Bronze Age began with the discovery of copper and copper-based metals. The wide application of new agricultural technologies such as the sickle, plow, windmill, and irrigation enabled farmers to grow more food. Sustained technological advancement caused many people to migrate from farms to developing towns and cities. Other influential developments in this age included weaving machines and the spinning wheel, which advanced the making of cloth. The invention of gunpowder and guns was an improvement over previous weapons for both hunting and protection.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	Interaction of Technology and Humans Changes caused by the introduction and use of a new technology can range from gradual to rapid and from subtle to obvious, and can change over time. These changes may vary from society to society as a result of differences in a society's economy, politics, and culture.	Attention to Ethics Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's farming and agricultural practices.

Pennsylvania Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.1: Make sense of problems and persevere in solving them. MP.3: Construct viable arguments and critique the reasoning of others. MP.7: Look for and make use of structure.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.KK Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *relate how technological and engineering developments have been evolutionary, often the result of a series of refinements to basic inventions or technological knowledge.*

Clarifying Statement: For example, the development of the pencil was a long and tedious process. Engineers, designers, and technicians developed many different techniques and processes and used a variety of materials in order to develop the best pencil possible. Agricultural techniques were developed to improve the cultivation of food and its supply. Other developments include better ways to communicate through the development of paper, ink, and the alphabet; to navigate with boats; to understand human anatomy; and to provide access to clean drinking water.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	Interaction of Technology and Humans Changes caused by the introduction and use of a new technology can range from gradual to rapid and from subtle to obvious, and can change over time. These changes may vary from society to society as a result of differences in a society's economy, politics, and culture.	Making and Doing Demonstrates the ability to regulate and improve making and doing skills.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Establish and pursue goals or post-secondary education, employment, and living within the community.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.LL Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop.*

Clarifying Statement: Automated control systems in a vehicle, for example, automatically detect and control the speed of the vehicle.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.	Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.	Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to manufacturing businesses and industries.

Pennsylvania Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.MM Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *troubleshoot and improve a flawed system embedded within a larger technological, social, or environmental system.*

Clarifying Statement: Systems are made up of components (i.e., subsystems). A food processor is only one component in a larger food preparation system that, in turn, is a component in a larger home system. Troubleshooting a flawed system or product allows students to identify possible areas for improvement. For example, a recycling program at their school might have very low participation rates by students and staff members. Investigating the components of the program (system) will help students identify ways to improve it.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	Maintenance and Troubleshooting - Analyze a system malfunction using logical reasoning (such as a fault tree) and appropriate diagnostic tools and instruments. Devise strategies and recommend tools for fixing the problem. Transfer Knowledge - Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.	Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system. Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.9-12.Q: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

Grades 9–12**3.5.9-12.NN Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *analyze the rate of technological and engineering development and predict future diffusion and adoption of new innovations and technologies.*

Clarifying Statement: The rate of development of inventions and innovations is affected by many factors, such as time and monetary investment. Many new technologies build upon previous technologies, often resulting in quick development and dispersion. For example, the rapid development of consumer scale drone technologies has built upon earlier military applications of these devices.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Developing & Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.	Developing Possible Solutions When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.	Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Evaluate consequences from a personal, and civic perspective to inform decision making.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.OO Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can use project management tools, strategies, and processes in planning, organizing, and controlling work.

Clarifying Statement: Management is sometimes defined as getting work done through other people. Teamwork, responsibility, and interpersonal dynamics play a significant role in the development and production of technological products. Management processes are used to oversee and guide these functions.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Planning and Carrying Out Investigations Planning and carrying out investigations in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.	Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.	Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes. Communication - Clearly conveys ideas in constructive ways, including through written and oral communication and via mathematical and physical models.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's food supply companies in the Commonwealth.

Pennsylvania Career Ready Skills: Evaluate behaviors in relation to the impact on self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.PP Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making.*

Clarifying Statement: When making final decisions for designs, it is important to consider all relationships between design choices and end product results. Models and prototypes of all kinds can be useful in troubleshooting these relationships prior to developing final solutions. These models can vary from high-tech software to low-cost physical models of solutions.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.	Models and Visualizations Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.	Making and Doing Demonstrates the ability to regulate and improve making and doing skills.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's manufacturing businesses and industry.

Pennsylvania Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

Grades 9–12**3.5.9-12.QQ Technology and Engineering:** Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *implement quality control as a planned process to ensure that a product, service, or system meets established criteria.*

Clarifying Statement: Quality control is concerned with how well a product, service, or system conforms to specifications and tolerances required by the design. For example, a set of rigorous international standards has been established to help companies systematically increase the quality of their products and operations.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Planning and Carrying Out Investigations Planning and carrying out investigations in 9-12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to Pennsylvania's manufacturing businesses and industry.

Pennsylvania Career Ready Skills: Evaluate behaviors in relation to the impact on self and others.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.11–12.G: Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic. CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	MP.5: Use appropriate tools strategically.
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	N/A

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