Technology & Engineering Curriculum Framework

Introduction

Science, Technology & Engineering, and Environmental Literacy & Sustainability (STEELS) Standards guide the study of the natural and human-made world through inquiry, problem-solving, critical thinking, and authentic exploration. This document displays a curriculum framework for the Technology & Engineering standards. It is designed to focus curriculum and teaching, provide guidance for multiple approaches to curriculum development, encourage less reliance on textbooks as curriculum, and avoid activity-oriented teaching without focus/purpose.

Technology & Engineering Long Term Transfer Goals

In support of the Curriculum Framework, Long Term Transfer Goals (LTTG) provide the overarching practices that ground the foundation for a robust curriculum; thus, all curriculum should relate to one or more of the LTTGs detailed below – as they highlight the effective uses of understanding, knowledge, and skill that we seek in the long run; i.e., what we want students to be able to do when they confront new challenges – both in and outside of school.

Students will be able to engage as technological and engineering literate members of a global society, using their learning to:

1. Analyze a problem in its entirety while recognizing the subcomponents interacting with human-made and natural environments.
2. Apply investigation, imagination, innovative thinking, and physical skills to accomplish goals.
3. Employ hands-on problem solving, i.e., designing, making/building, producing, and evaluating outcomes.
4. Acquire, analyze, and evaluate information to reach an informed conclusion, using logic and reasoning skills.
5. Investigate better solutions through a belief that opportunities can be found in every challenge.
6. Collaborate as part of a team, valuing the contributions of all members.
7. Exchange and explain ideas by sharing information with a larger community.
8. Demonstrate integrity and conscientiousness, considering ethical issues involved.

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Strand: Nature and Characteristics of Technology and Engineering							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	The study of technology and engineering requires knowledge of the natural world and the human-made world.	Why is it important to have an understanding of the natural and human-made worlds?	3.5.K-2.BB Compare the natural world and the human-made world.	**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.	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,	natural world human-made compare
3-5	The study of technology and engineering requires knowledge of the natural world and the human-made world.	Why is it important to have an understanding of the natural and human-made worlds?	3.5.3-5.FF Compare how things found in nature differ from things that are human-made, noting differences and similarities in how they are produced and used.	**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 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.	natural world human-made world resource
	The study of technology and engineering requires knowledge of the natural world and the human-made world.	Why is it important to have an understanding of the natural and human-made worlds?	3.5.3-5.GG Describe the unique relationship between science and technology, and how the natural world can contribute to the human-made world to foster innovation.	**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.	innovation energy science technology contribute

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6-8	The study of technology and engineering requires knowledge of the natural world and the human-made world.	Why is it important to have an understanding of the natural and human-made worlds?	**3.5.6-8.KK** Explain how technology and engineering are closely linked to creativity, which can result in both intended and unintended innovations.	**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.	Technology advances through the processes of innovation and invention. Sometimes a technology developed for one purpose is adapted to serve other purposes.	**Creativity** Defends technological decisions based on evidence. **Making and Doing** Exhibits safe, effective ways of producing technological products, systems, and processes.	engineering creativity natural-world human-made innovation
9-12	Intentionally Blank						

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K-2	The study of technology and engineering as a human activity is interdisciplinary.	How does the interdisciplinary nature of technology and engineering influence human activity?	3.5.K-2.CC Discuss the roles of scientists, engineers, technologists and others who work with technology.	**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. Use words, tables, diagrams, and graphs (whether in hard copy or electronically), as well as mathematical expressions, to communicate their understanding or to ask questions about a system under study.	**N/A**	**Communication** Learns that humans have many ways to communicate.	scientist engineer technologist technology interdisciplinary
3-5	The study of technology and engineering as a human activity is interdisciplinary.	How does the interdisciplinary nature of technology and engineering influence human activity?	3.5.3-5.HH Differentiate between the role of scientists, engineers, technologists, and others in creating and maintaining technological systems.	**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.	technologist engineer
	The study of technology and engineering as a human activity is interdisciplinary.	How does the interdisciplinary nature of technology and engineering influence human activity?	3.5.3-5.EE Explain how solutions to problems are shaped by economic, political, and cultural forces.	**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 itmeets the criteria and constraints of the problem.	**N/A**	**Systems Thinking** Provides examples of how human-designed products are connected.	interdisciplinary influence system solution financial resource cultural political

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
6-8	The study of technology and engineering as a human activity is interdisciplinary.	How does the interdisciplinary nature of technology and engineering influence human activity?	3.5.6-8.II Predict outcomes of a future product or system at the beginning of the design process.	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.	**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.	**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.	design process interdisciplinary outcome
	The study of technology and engineering as a human activity is interdisciplinary.	How does the interdisciplinary nature of technology and engineering influence human activity?	3.5.6-8.LL Compare how different technologies involve different sets of processes.	There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	**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** Uses the systems model to show how parts of technological systems work together.	evaluate
9-12	The study of technology and engineering as a human activity is interdisciplinary.	How does the interdisciplinary nature of technology and engineering influence human activity?	3.5.9-12.NN Analyze the rate of technological and engineering development and predict future diffusion and adoption of new innovations and technologies.	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.	**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.	**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.	invention innovation diffusion interdisciplinary

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	The study of technology and engineering involves the ability to understand, use, assess, and create technological products, systems, and ways of thinking.	Why is it important to understand, use, assess, and create technological products, systems, and ways of thinking?	3.5.K-2.AA Demonstrate that creating can be done by anyone.	**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.	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.	technology engineering technological products technological systems tools techniques
3-5	Intentionally Blank						
6-8	The study of technology and engineering involves the ability to understand, use, assess, and create technological products, systems, and ways of thinking.	Why is it important to understand, use, assess, and create technological products, systems, and ways of thinking?	3.5.6-8.JJ Apply informed problem-solving strategies to the improvement of existing devices or processes or the development of new approaches.	**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.	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.	iterative product systems
9-12	The study of technology and engineering involves the ability to understand, use, assess, and create technological products, systems, and ways of thinking.	Why is it important to understand, use, assess, and create technological products, systems, and ways of thinking?	3.5.9-12.PP 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.	**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.	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.	model prototype graphical virtual mathematical physical troubleshooting simulation

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K-2	Technology and engineering activities require resources.	How are various resources used in technology and engineering activities?	3.5.K-2.DD Collaborate effectively as a member of a team.	**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.	collaborate team
3-5	Intentionally Blank						
6-8	Intentionally Blank						
9-12	Technology and engineering activities require resources.	How are various resources used in technology and engineering activities?	3.5.9-12.OO Use project management tools, strategies, and processes in planning, organizing, and controlling work.	**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.	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.	**Collaboration** Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes. **Communication** Conveys ideas clearly in constructive insightful ways, including through written and oral communication and via mathematical and physical models.	project management teamwork responsibility plan organize control
9-12	Technology and engineering activities require resources.	How are various resources used in technology and engineering activities?	3.5.9-12.QQ Implement quality control as a planned process to ensure that a product, service, or system meets established criteria.	**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.	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.	**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.	quality control planned process criteria

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K-2	A system is a group of interrelated components designed collectively to achieve a desired goal.	How do system components work together to achieve a desired goal?	3.5.K-2.Z Illustrate how systems have parts or components that work together to accomplish a goal.	**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. Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).	A situation that people want to change or create can be approached as a problem to be solved through engineering. In solving the problem, there may be different parts that need to connect.	**Systems Thinking** Learns that human-designed things are connected.	illustrate system part goal
3-5	A system is a group of interrelated components designed collectively to achieve a desired goal.	How do system components work together to achieve a desired goal?	3.5.3-5.BB Illustrate how, when parts of a system are missing, it may not work as planned.	**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).	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.	system part component
	A system is a group of interrelated components designed collectively to achieve a desired goal.	How do system components work together to achieve a desired goal?	3.5.3-5.CC Describe how a subsystem is a system that operates as a part of another larger system.	**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.	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.	subsystem system distribution

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	A system is a group of interrelated components designed collectively to achieve a desired goal.	How do system components work together to achieve a desired goal?	3.5.3-5.DD Demonstrate how simple technologies are often combined to form more complex systems.	**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.	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.	technology system construct escalator
6-8	A system is a group of interrelated components designed collectively to achieve a desired goal.	How do system components work together to achieve a desired goal?	3.5.6-8.EE Differentiate between inputs, processes, outputs, and feedback in technological systems.	**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).	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.	input resource output feedback
6-8	A system is a group of interrelated components designed collectively to achieve a desired goal.	How do system components work together to achieve a desired goal?	3.5.6-8.FF 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.	**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.	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.	systems thinking relationship environment

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	A system is a group of interrelated components designed collectively to achieve a desired goal.	How do system components work together to achieve a desired goal?	**3.5.6-8.GG** Create an open-loop system that has no feedback path and requires human intervention.	**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.	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.	open-loop system intervention
	A system is a group of interrelated components designed collectively to achieve a desired goal.	How do system components work together to achieve a desired goal?	**3.5.6-8.HH** Create a closed-loop system that has a feedback path and requires no human intervention.	**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.	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.	closed-loop system
9-12	A system is a group of interrelated components designed collectively to achieve a desired goal.	How do system components work together to achieve a desired goal?	**3.5.9-12.LL** 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.	**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.	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.	stability analysis interrelated influence component feedback loop automatic manual control

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	A system is a group of interrelated components designed collectively to achieve a desired goal.	How do system components work together to achieve a desired goal?	3.5.9-12.MM Troubleshoot and improve a flawed system embedded within a larger technological, social, or environmental system.	**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.	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. 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.	troubleshoot embed improve system technological social environmental investigate flaw

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K-2	Intentionally Blank						
3-5	Intentionally Blank						
6-8	Intentionally Blank						
9-12	Historically, technological knowledge has accelerated along with other fields.	Why does technological knowledge often accelerate alongside other fields?	**3.5.9-12.JJ** 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.	**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.	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.	evolve civilization affect development age tool material process technology

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K-2	Historical eras are often defined by technological advancements.	How do technological advancements define different historical eras?	3.5.K-2.Y Discuss how the way people live and work has changed throughout history because of technology.	**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.	Asking questions, making observations, and gathering information are helpful in thinking about problems.	**Critical Thinking** Engage in listening, questioning, and discussing.	discuss communicate tool process
	Historical eras are often defined by technological advancements.	How do technological advancements define different historical eras?	3.5.K-2.I Compare simple technologies to evaluate their impacts.	**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.	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.	compare evaluate impact
3-5	Historical eras are often defined by technological advancements.	How do technological advancements define different historical eras?	3.5.3-5.AA Create representations of the tools people made, how they cultivated to provide food, made clothing, and built shelters to protect themselves.	**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.	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.	tool shelter product variation

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	Historical eras are often defined by technological advancements.	How do technological advancements define different historical eras?	3.5.3-5.K Judge technologies to determine the best one to use to complete a given task or meet a need.	**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.	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.	historical era
6-8	Historical eras are often defined by technological advancements.	How do technological advancements define different historical eras?	3.5.6-8.CC Consider historical factors that have contributed to the development of technologies and human progress.	**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.	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.	historical era technological advancement human progress
9-12	Historical eras are often defined by technological advancements.	How do technological advancements define different historical eras?	3.5.9-12.GG Evaluate how technology and engineering have been powerful forces in reshaping the social, cultural, political, and economic landscapes throughout history.	**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	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.	era social cultural political economic landscape context scenario

Technology & Engineering Curriculum Framework

Strand: Nature and Characteristics of Technology and Engineering							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
				them in simpler but still accurate terms.			
	Historical eras are often defined by technological advancements.	How do technological advancements define different historical eras?	3.5.9-12.HH 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.	**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.	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.	development Industrial Revolution mass production transportation communication system construction education leisure efficiency access
	Historical eras are often defined by technological advancements.	How do technological advancements define different historical eras?	3.5.9-12.II Investigate the widespread changes that have resulted from the Information Age, which has placed emphasis on the processing and exchange of information.	**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.	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.	Information Age processing exchange data information

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Strand: Nature and Characteristics of Technology and Engineering							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	Intentionally Blank						
3-5	Intentionally Blank						
6-8	Historically, technology has both created and solved problems.	How has technology both created and solved problems?	**3.5.6-8.DD** Engage in a research and development process to simulate how inventions and innovations have evolved through systematic tests and refinements.	**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.	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.	**Optimism** Critiques technological products and systems to identify areas of improvement.	research and development systematic test refinement
9-12	Historically, technology has both created and solved problems.	How has technology both created and solved problems?	**3.5.9-12.KK** Relate how technological and engineering developments have been evolutionary, often the result of a series of refinements to basic inventions or technological knowledge.	**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.	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.	evolutionary refinement invention innovation engineer designer technician technique process

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Strand: Applying, Maintaining, and Assessing Technological Products and Systems

Grade	Big Ideas	Essential Questions	Standards	Science and Engineering Practices	Disciplinary Core Ideas	Technology and Engineering Practices	Vocabulary
K-2	Technologically literate people are well equipped to learn about and use technological products and systems.	Why is it important for people to be technologically literate?	3.5.K-2.A Identify and use everyday symbols.	**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.	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.	symbol communication
	Technologically literate people are well equipped to learn about and use technological products and systems.	Why is it important for people to be technologically literate?	3.5.K-2.G Explain the tools and techniques that people use to help them do things.	**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.	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.	tool technique
3-5	Technologically literate people are well equipped to learn about and use technological products and systems.	Why is it important for people to be technologically literate?	3.5.3-5.I Design solutions by safely using tools, materials, and skills.	**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.	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. 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.	tool material skill resource

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Strand: Applying, Maintaining, and Assessing Technological Products and Systems

Grade	Big Ideas	Essential Questions	Standards	Science and Engineering Practices	Disciplinary Core Ideas	Technology and Engineering Practices	Vocabulary
6-8	Technologically literate people are well equipped to learn about and use technological products and systems.	Why is it important for people to be technologically literate?	3.5.6-8.A Research information from various sources to use and maintain technological products or systems.	**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.	Models of all kinds are important for testing solutions.	**Communication** Exhibits effective technical writing, graphic, and oral communication abilities.	technologically literate
	Technologically literate people are well equipped to learn about and use technological products and systems.	Why is it important for people to be technologically literate?	3.5.6-8.B Use instruments to gather data on the performance of everyday products.	**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.	There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Select and use appropriate digital and network tools and media resources to collect, organize, analyze, and display supporting.	**Systems Thinking** Uses the systems model to show how parts of technological systems work together.	instruments data products
9-12	Technologically literate people are well equipped to learn about and use technological products and systems.	Why is it important for people to be technologically literate?	3.5.9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.	**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	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 their needs.	**Communication** Clearly coveys ideas in constructive ways, including through written and oral communication and via mathematical and physical models.	technological literacy communication process procedure maintain assess

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Strand: Applying, Maintaining, and Assessing Technological Products and Systems							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
				them in simpler but still accurate terms.			

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Strand: Applying, Maintaining, and Assessing Technological Products and Systems							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	Maintenance and repair of a technological product, system, or process is crucial to keeping it in proper working order.	How can a product, system, or process be kept in proper working order?	3.5.K-2.K Safely use tools to complete tasks.	**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.	safety task tool
3-5	Maintenance and repair of a technological product, system, or process is crucial to keeping it in proper working order.	How can a product, system, or process be kept in proper working order?	3.5.3-5.L Demonstrate how tools and machines extend human capabilities, such as holding, lifting, carrying, fastening, separating, and computing.	**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.	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.	capability machine
6-8	Maintenance and repair of a technological product, system, or process is crucial to keeping it in proper working order.	How can a product, system, or process be kept in proper working order?	3.5.6-8.J Use tools, materials, and machines to safely diagnose, adjust, and repair systems.	**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.	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.	tool machine diagnosis

	Maintenance and repair of a technological product, system, or process is crucial to keeping it in proper working order.	How can a product, system, or process be kept in proper working order?	3.5.6-8.K Use devices to control technological systems.	**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.	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.	device vehicle
9-12	Intentionally Blank						

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^Strand: Applying, Maintaining, and Assessing Technological Products and Systems							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	People should gather, synthesize, and analyze information before drawing conclusions when assessing a technological product, system, or process.	How can information be used to evaluate technological products, systems and processes?	3.5.K-2.B Describe qualities of everyday products.	**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).	Different properties are suited for different purposes.	**Communication** Learns that humans have many ways to communicate.	quality product
3-5	People should gather, synthesize, and analyze information before drawing conclusions when assessing a technological product, system, or process.	How can information be used to evaluate technological products, systems and processes?	3.5.3-5.B Examine information to assess the trade-offs to using a product or system.	**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.	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.	gather synthesize draw conclusion
6-8	People should gather, synthesize, and analyze information before drawing conclusions when assessing a technological product, system, or process.	How can information be used to evaluate technological products, systems and processes?	3.5.6-8.O Interpret the accuracy of information collected.	**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.	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.	criteria accuracy precision judgment

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
	People should gather, synthesize, and analyze information before drawing conclusions when assessing a technological product, system, or process.	How can information be used to evaluate technological products, systems and processes?	3.5.6-8.P (ETS) Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	**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.	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.	systematic criteria constraints
9-12	Intentionally Blank						

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Strand: Applying, Maintaining, and Assessing Technological Products and Systems

Grade	Big Ideas	Essential Questions	Standards	Science and Engineering Practices	Disciplinary Core Ideas	Technology and Engineering Practices	Vocabulary
K-2	Technology and engineering have both positive and negative impacts on society and the environment.	How can one assess the impact of technology and engineering on society?	3.5.K-2.J Design new technologies that could improve their daily lives.	**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.	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.	technologies
3-5	Intentionally Blank						
6-8	Technology and engineering have both positive and negative impacts on society and the environment.	How can one assess the impact of technology and engineering on society?	3.5.6-8.I Examine the ways that technology can have both positive and negative effects at the same time.	**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).	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.	beneficial solution positive impact negative impact
9-12	Technology and engineering have both positive and negative impacts on society and the environment.	How can one assess the impact of technology and engineering on society?	3.5.9-12.H Evaluate ways that technology and engineering can impact individuals, society, and the environment.	**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,	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. 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.	evaluate technology engineering individual society environment impact sustainability

Strand: Applying, Maintaining, and Assessing Technological Products and Systems							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
				new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.			
	Technology and engineering have both positive and negative impacts on society and the environment.	How can one assess the impact of technology and engineering on society?	**3.5.9-12.I (ETS)** Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.	**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. Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.	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.	prioritized criteria trade offs aesthetics

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	Intentionally Blank						
3-5	Intentionally Blank						
6-8	Decisions made about technology and engineering involve consideration of costs, benefits, and tradeoffs.	How do costs, benefits, and tradeoffs factor into decisions made about technology and engineering?	3.5.6-8.L Design methods to gather data about technological systems.	**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.	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.	data method cost benefit trade-off
	Decisions made about technology and engineering involve consideration of costs, benefits, and tradeoffs.	How do costs, benefits, and tradeoffs factor into decisions made about technology and engineering?	3.5.6-8.M (ETS) 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.	**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.	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. 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** Shows persistence in addressing technological problems and finding solutions to those problems.	iterative process model optimal design
	Decisions made about technology and engineering involve consideration of costs, benefits, and tradeoffs.	How do costs, benefits, and tradeoffs factor into decisions made about technology and engineering?	3.5.6-8.N (ETS) 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.	**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.	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. 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	**Optimism** Shows persistence in addressing technological problems and finding solutions to those problems.	characteristics systematic processes criteria constraints

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Strand: Applying, Maintaining, and Assessing Technological Products and Systems							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
					characteristics may be incorporated into the new design.		
9-12	Decisions made about technology and engineering involve consideration of costs, benefits, and tradeoffs.	How do costs, benefits, and tradeoffs factor into decisions made about technology and engineering?	3.5.9-12.J Synthesize data and analyze trends to make decisions about technological products, systems, or processes.	**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.	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.	data information synthesis analysis trend product system process benefit tradeoff
	Decisions made about technology and engineering involve consideration of costs, benefits, and tradeoffs.	How do costs, benefits, and tradeoffs factor into decisions made about technology and engineering?	3.5.9-12.K(ETS) 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.	**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.	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.	engineering design process computer simulation systems model

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.	Why is it important to sustainably manage technological resources?	**3.5.K-2.D** Select ways to reduce, reuse, and recycle resources in daily life.	**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.	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. 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.	reduce reuse recycle resource
3-5	Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.	Why is it important to sustainably manage technological resources?	**3.5.3-5.G** Describe the helpful and harmful effects of technology.	**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 trade-offs.	helpful harmful effect technology
	Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.	Why is it important to sustainably manage technological resources?	**3.5.3-5.E** Explain why responsible use of technology requires sustainable management of resources.	**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 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.	sustainable sustainability renewable nonrenewable waste

Strand: Applying, Maintaining, and Assessing Technological Products and Systems							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
	Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.	Why is it important to sustainably manage technological resources?	3.5.3-5.F Classify resources used to create technologies as either renewable or non-renewable.	**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.	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.	classify renewable nonrenewable
6-8	Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.	Why is it important to sustainably manage technological resources?	3.5.6-8.E Consider the impacts of a proposed or existing technology and devise strategies for reducing, reusing, and recycling waste caused by its creation.	**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.	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.	sustainable renewable nonrenewable waste
	Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.	Why is it important to sustainably manage technological resources?	3.5.6-8.D Analyze how the creation and use of technologies consumes renewable, non-renewable, and inexhaustible resources; creates waste; and may contribute to environmental challenges.	**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.	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.	inexhaustible consume by-product

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Strand: Applying, Maintaining, and Assessing Technological Products and Systems							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
9-12	Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.	Why is it important to sustainably manage technological resources?	3.5.9-12.C Develop a solution to a technological problem that has the least negative environmental and social impact.	**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.	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.	development solution technological problem impact sustainability identification analysis investigation design
	Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.	Why is it important to sustainably manage technological resources?	3.5.9-12.D Critique whether existing or proposed technologies use resources sustainably.	**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.	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	**Attention to Ethics** Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.	critique sustainability evaluate investigate
	Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.	Why is it important to sustainably manage technological resources?	3.5.9-12.B Critically assess and evaluate a technology that minimizes resource use and resulting waste to achieve a goal.	**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	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.	**Critical Thinking** Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.	assess critical thinking evaluate resource waste goal solution impact

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				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.			by-product

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	The needs and wants of society often shape technology and engineering developments.	How does technology and engineering address the needs and wants of society?	3.5.K-2.C Explain ways that technology helps with everyday tasks.	**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.	Asking questions, making observations, and gathering information are helpful in thinking about problems.	**Communication** Learns that humans have many ways to communicate.	task technology help
	The needs and wants of society often shape technology and engineering developments.	How does technology and engineering address the needs and wants of society?	3.5.K-2.H Explain the needs and wants of individuals and societies.	**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.	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.	need want individual society
	The needs and wants of society often shape technology and engineering developments.	How does technology and engineering address the needs and wants of society?	3.5.K-2.L Explore how technologies are developed to meet individual and societal needs and wants.	**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.	Before beginning to design a solution, it is important to clearly understand the problem	**Systems Thinking** Learns that human-designed things are connected.	societal needs wants
3-5	The needs and wants of society often shape technology and engineering developments.	How does technology and engineering address the needs and wants of society?	3.5.3-5.D Predict how certain aspects of their daily lives would be different without given technologies.	**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	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.	predict need want

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				and describe how they are supported by evidence.			
	The needs and wants of society often shape technology and engineering developments.	How does technology and engineering address the needs and wants of society?	3.5.3-5.J Explain how technologies are developed or adapted when individual or societal needs and wants change.	**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.	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.	change develop adapt
6-8	The needs and wants of society often shape technology and engineering developments.	How does technology and engineering address the needs and wants of society?	3.5.6-8.C Hypothesize what alternative outcomes (individual, cultural, and/or environmental) might have resulted had a different technological solution been selected.	**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.	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.	hypothesize positive outcome negative outcome need want
	The needs and wants of society often shape technology and engineering developments.	How does technology and engineering address the needs and wants of society?	3.5.6-8.G Analyze how an invention or innovation was influenced by the context and circumstances in which it is developed.	**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	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** Defends technological decisions based on evidence.	invention innovation

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Grade	Big Ideas	Essential Questions	Standards	Science and Engineering Practices	Disciplinary Core Ideas	Technology and Engineering Practices	Vocabulary
				about the natural and designed world(s).			
9-12	The needs and wants of society often shape technology and engineering developments.	How does technology and engineering address the needs and wants of society?	3.5.9-12.F Evaluate a technological innovation that arose from a specific society's unique need or want.	**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.	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.	innovation need want society
	The needs and wants of society often shape technology and engineering developments.	How does technology and engineering address the needs and wants of society?	3.5.9-12.M Develop a device or system for the marketplace.	**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 trade-off considerations.	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.	develop device system marketplace research & development production

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	The values and beliefs of societies shape attitudes toward technology.	How do the values and beliefs of societies shape attitudes toward technology?	3.5.K-2.I Compare simple technologies to evaluate their impacts.	**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.	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.	compare evaluate impact
3-5	The values and beliefs of societies shape attitudes toward technology.	How do the values and beliefs of societies shape attitudes toward technology?	3.5.3-5.K Judge technologies to determine the best one to use to complete a given task or meet a need.	**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.	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.	judge (verb)
6-8	The values and beliefs of societies shape attitudes toward technology.	How do the values and beliefs of societies shape attitudes toward technology?	3.5.6-8.H Evaluate trade-offs based on various perspectives as part of a decision process that recognizes the need for careful compromises among competing factors.	**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.	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.	perspective compromise unsustainable obsolete consumption

Strand: Applying, Maintaining, and Assessing Technological Products and Systems							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
9-12	The values and beliefs of societies shape attitudes toward technology.	How do the values and beliefs of societies shape attitudes toward technology?	3.5.9-12.G Evaluate a technological innovation that was met with societal resistance impacting its development.	**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.	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.	evaluate innovation society resistance norm development resolve conflict consensus value
	The values and beliefs of societies shape attitudes toward technology.	How do the values and beliefs of societies shape attitudes toward technology?	3.5.9-12.L Interpret laws, regulations, policies, and other factors that impact the development and use of technology.	**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.	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** Conveys ideas clearly in constructive, insightful ways, including through written and oral communication and via mathematical and physical models.	interpret law regulation policy develop use

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Strand: Applying, Maintaining, and Assessing Technological Products and Systems							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	Use of technology can lead to fundamental changes in individuals, human cultures, and the environment.	How does changing technology impact the individual, culture, and environment?	3.5.K-2.E Illustrate helpful and harmful effects of technology.	**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.	technology illustrate
	Use of technology can lead to fundamental changes in individuals, human cultures, and the environment.	How does changing technology impact the individual, culture, and environment?	3.5.K-2.F Investigate the use of technologies in the home and community.	**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.	Asking questions, making observations, and gathering information are helpful in thinking about problems.	**Critical Thinking** Engages in listening, questioning, and discussing.	investigate community
3-5	Use of technology can lead to fundamental changes in individuals, human cultures, and the environment.	How does changing technology impact the individual, culture, and environment?	3.5.3-5.H Determine factors that influence changes in a society's technological systems or infrastructure.	**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.	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.	culture environment individual change infrastructure

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6-8	Use of technology can lead to fundamental changes in individuals, human cultures, and the environment.	How does changing technology impact the individual, culture, and environment?	3.5.6-8.F Analyze examples of technologies that have changed the way people think, interact, live, and communicate.	**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).	Apply scientific principles to design a method for monitoring and minimizing human impact on the environment. 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.	culture fundamental
9-12	Use of technology can lead to fundamental changes in individuals, human cultures, and the environment.	How does changing technology impact the individual, culture, and environment?	3.5.9-12.E Evaluate how technology and engineering advancements alter human health and capabilities.	**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.	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.	evaluate advancement alteration capability examine effect impact

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Strand: Integration of Knowledge, Technologies, and Practices							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	Technology and engineering are interdisciplinary, relating to more than one content area.	How does technology and engineering relate to other content areas?	3.5.K-2.R Draw connections between technology and human experiences.	**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.	connections technology
	Technology and engineering are interdisciplinary, relating to more than one content area.	How does technology and engineering relate to other content areas?	3.5.K-2.W Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple areas.	**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.	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.	apply discipline
3-5	Technology and engineering are interdisciplinary, relating to more than one content area.	How does technology and engineering relate to other content areas?	3.5.3-5.X Explain how various relationships can exist between technology and engineering and other content areas.	**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.	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** Works in small groups to complete design-based projects.	relationship content exist discipline

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Strand: Integration of Knowledge, Technologies, and Practices							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
6-8	Technology and engineering are interdisciplinary, relating to more than one content area.	How does technology and engineering relate to other content areas?	3.5.6-8.Y Compare, contrast, and identify overlap between the contributions of science, technology, engineering, and mathematics in the development of technological systems.	**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).	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.	contribution academic discipline
	Technology and engineering are interdisciplinary, relating to more than one content area.	How does technology and engineering relate to other content areas?	3.5.6-8.Z Analyze how different technological systems often interact with economic, environmental, and social systems.	**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.	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.	economic social system
	Technology and engineering are interdisciplinary, relating to more than one content area.	How does technology and engineering relate to other content areas?	3.5.6-8.BB Demonstrate how knowledge gained from other content areas affects the development of technological products and systems.	**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 and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.	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.	development

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Strand: Integration of Knowledge, Technologies, and Practices

Grade	Big Ideas	Essential Questions	Standards	Science and Engineering Practices	Disciplinary Core Ideas	Technology and Engineering Practices	Vocabulary
9-12	Technology and engineering are interdisciplinary, relating to more than one content area.	How does technology and engineering relate to other content areas?	**3.5.9-12.BB** Assess how similarities and differences among scientific, technological, engineering, and mathematical knowledge and skills contributed to the design of a product or system.	**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.	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.	assess relate similarity difference interdisciplinary developing improving expertise contribute
	Technology and engineering are interdisciplinary, relating to more than one content area.	How does technology and engineering relate to other content areas?	**3.5.9-12.DD** Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.	**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.	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.	technological literacy synthesize knowledge improve design construct execute plan solve

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Strand: Integration of Knowledge, Technologies, and Practices

Grade	Big Ideas	Essential Questions	Standards	Science and Engineering Practices	Disciplinary Core Ideas	Technology and Engineering Practices	Vocabulary
K-2	Technological knowledge and practices advance – and are advanced by – other fields.	How do advancements from one field impact another?	3.5.K-2.V Explain that materials are selected for use because they possess desirable properties and characteristics.	**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.	Different properties are suited to different purposes. A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.	**Communication** Learns that humans have many ways to communicate.	property characteristic plan task
	Technological knowledge and practices advance – and are advanced by – other fields.	How do advancements from one field impact another?	3.5.K-2.X Develop a plan in order to complete a task.	**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.	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.	task plan
3-5	Technological knowledge and practices advance – and are advanced by – other fields.	How do advancements from one field impact another?	3.5.3-5.W Describe the properties of different materials.	**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.	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 gasses 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.	property application
	Technological knowledge and practices advance – and are advanced by – other fields.	How do advancements from one field impact another?	3.5.3-5.Y Identify the resources needed to get a technical job done, such as people, materials, capital, tools, machines, knowledge, energy, and time.	**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.	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.	material capital resource

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Grade	Big Ideas	Essential Questions	Standards	Science and Engineering Practices	Disciplinary Core Ideas	Technology and Engineering Practices	Vocabulary
	Technological knowledge and practices advance – and are advanced by – other fields.	How do advancements from one field impact another?	3.5.3-5.Z Create a new product that improves someone's life.	**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.	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. 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. 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.	improve invention innovation
6-8	Technological knowledge and practices advance – and are advanced by – other fields.	How do advancements from one field impact another?	3.5.6-8.AA Adapt and apply an existing product, system, or process to solve a problem in a different setting.	**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/or test a design of an object, tool, process or system.	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** Tries new technologies and generates strategies for improving existing ideas.	adapt advancement

Strand: Integration of Knowledge, Technologies, and Practices

Grade	Big Ideas	Essential Questions	Standards	Science and Engineering Practices	Disciplinary Core Ideas	Technology and Engineering Practices	Vocabulary
9-12	Technological knowledge and practices advance – and are advanced by – other fields.	How do advancements from one field impact another?	3.5.9-12.CC Analyze how technology transfer occurs when a user applies an existing innovation developed for one function for a different purpose.	**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.	Design, build, and refine a device that works within given constraints to convert on form of energy into another form of energy. 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.	innovation invention setting transfer develop function purpose field of study advance
	Technological knowledge and practices advance – and are advanced by – other fields.	How do advancements from one field impact another?	3.5.9-12.EE Connect technological and engineering progress to the advancement of other areas of knowledge and vice versa.	**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.	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. 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.	advancement traverse progress
	Technological knowledge and practices advance – and are advanced by – other fields.	How do advancements from one field impact another?	3.5.9-12.FF Evaluate how technology enhances opportunities for new products and services through globalization.	**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.	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.	exponential growth innovation invention advancement opportunity globalization product service

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Strand: Design in Technology & Engineering Education							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	Intentionally Blank						
3-5	Intentionally Blank						
6-8	Intentionally Blank						
9-12	Design is a fundamental human activity.	Why is design important to human activity?	3.5.9-12.Z Recognize and explain how their community and the world around them informs technological development and engineering design.	**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.	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.	community development design

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	There is no single, best solution as designs can always be improved and refined.	Why is there no single correct solution in design?	3.5.K-2.O Illustrate that there are different solutions to a design and that none are perfect.	**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.	A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.	**Optimism** Sees opportunities for making technologies better.	illustrate solution design want need plausible
	There is no single, best solution as designs can always be improved and refined.	Why is there no single correct solution in design?	3.5.K-2.U Explain that design is a response to wants and needs.	**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.	Asking questions, making observations, and gathering information are helpful in thinking about problems.	**Communication** Learns that humans have many ways to communicate.	need want
3-5	There is no single, best solution as designs can always be improved and refined.	Why is there no single correct solution in design?	3.5.3-5.V Interpret how good design improves the human condition.	**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.	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.	design

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	There is no single, best solution as designs can always be improved and refined.	Why is there no single correct solution in design?	3.5.3-5.S Illustrate that there are multiple approaches to design.	**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.	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.	design
6-8	There is no single, best solution as designs can always be improved and refined.	Why is there no single correct solution in design?	3.5.6-8.S Illustrate the benefits and opportunities associated with different approaches to design.	**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.	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.	Improved refined
	There is no single, best solution as designs can always be improved and refined.	Why is there no single correct solution in design?	3.5.6-8.X Defend decisions related to a design problem.	**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.	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.	empathy flexible thinking accountability metacognition

9-12	There is no single, best solution as designs can always be improved and refined.	Why is there no single correct solution in design?	3.5.9-12.P Apply a broad range of design skills to a design thinking process.	**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 trade-off considerations.	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.	creativity collaboration resourcefulness ideation design thinking

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
	There is no single, best solution as designs can always be improved and refined.	Why is there no single correct solution in design?	3.5.9-12.U Evaluate and define the purpose of a design.	**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.	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** Conveys ideas clearly in constructive, insightful ways, including through written and oral communication and via mathematical and physical models.	trade-off resource criteria constraint function form purpose evaluate define
	There is no single, best solution as designs can always be improved and refined.	Why is there no single correct solution in design?	3.5.9-12.X Implement the best possible solution to a design using an explicit process.	**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 ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	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. 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.	optimization explicit process design
	There is no single, best solution as designs can always be improved and refined.	Why is there no single correct solution in design?	3.5.9-12.Y (ETS) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	**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 a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.	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.	engineering systematically priority

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
K-2	Design in technology and engineering is iterative.	What is the value of iteration within the design process?	3.5.K-2.N Analyze how things work.	**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.	Before beginning to design a solution, it is important to clearly understand the problem.	**Critical Thinking** Engages in listening, questioning, and discussing.	analyze deconstruction construction
3-5	Design in technology and engineering is iterative.	What is the value of iteration within the design process?	3.5.3-5.N Identify why a product or system is not working properly.	**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.	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.	system iteration troubleshooting
6-8	Intentionally Blank						
9-12	Design in technology and engineering is iterative.	What is the value of iteration within the design process?	3.5.9-12.O Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality.	**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 ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	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. 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.	design thinking diagnose adjust repair precise safe proper functionality monitor maintenance iterate

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Grade	Big Ideas	Essential Questions	Standards	Science and Engineering Practices	Disciplinary Core Ideas	Technology and Engineering Practices	Vocabulary
K-2	There are requisite skills used in technology and engineering design.	How are requisite skills applied in technology and engineering design?	[3.5.K-2.M] Demonstrate essential skills of the engineering design process.	**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.	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.	demonstrate essential skills necessary design
	There are requisite skills used in technology and engineering design.	How are requisite skills applied in technology and engineering design?	[3.5.K-2.Q] Apply skills necessary for making in design.	**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.	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.	design
3-5	There are requisite skills used in technology and engineering design.	How are requisite skills applied in technology and engineering design?	[3.5.3-5.M] Demonstrate essential skills of the engineering design process.	**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.	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. 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	**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.	solution constraint limitation

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Strand: Design in Technology & Engineering Education							
Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
					suggest the elements of the design that need to be improved. Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.		
	There are requisite skills used in technology and engineering design.	How are requisite skills applied in technology and engineering design?	3.5.3-5.Q Practice successful design skills.	**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.	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. 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. 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.	solution constraint limitation

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Grade	Big Ideas	Essential Questions	Standards	Science and Engineering Practices	Disciplinary Core Ideas	Technology and Engineering Practices	Vocabulary
	There are requisite skills used in technology and engineering design.	How are requisite skills applied in technology and engineering design?	3.5.3-5.R Apply tools, techniques, and materials in a safe manner as part of the design process.	**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.	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.	solution constraint limitation
6-8	There are requisite skills used in technology and engineering design.	How are requisite skills applied in technology and engineering design?	3.5.6-8.Q Apply a technology and engineering design thinking process.	**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.	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 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. Models of all kinds are important for testing solutions.	**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.	iteration design thinking process
	There are requisite skills used in technology and engineering design.	How are requisite skills applied in technology and engineering design?	3.5.6-8.T Create solutions to problems by identifying and applying human factors in design.	**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.	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.	human factors

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Grade	**Big Ideas**	**Essential Questions**	**Standards**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Technology and Engineering Practices**	**Vocabulary**
9-12	There are requisite skills used in technology and engineering design.	How are requisite skills applied in technology and engineering design?	3.5.9-12.N Analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems.	**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 ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	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.	analysis use requisite skill empathy ideation design thinking
	There are requisite skills used in technology and engineering design.	How are requisite skills applied in technology and engineering design?	3.5.9-12.R Use a design thinking process to design an appropriate technology for use in a different culture.	**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 trade-off considerations.	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.	examine culture design thinking access

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	There are requisite skills used in technology and engineering design.	How are requisite skills applied in technology and engineering design?	**3.5.9-12.V** Apply principles of human-centered design.	**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 trade-off considerations.	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.	human-centered design principle relationship designed environment ergonomics designing constructing implementing

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K-2	There are universal principles and elements of design.	How are designs influenced by universal principles and elements of design?	3.5.K-2.P Discuss that all designs have different characteristics that can be described.	**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.	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.	characteristic describe
3-5	There are universal principles and elements of design.	How are designs influenced by universal principles and elements of design?	3.5.3-5.P Evaluate the strengths and weaknesses of existing design solutions, including their own solutions.	**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.	Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. 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.	solution constraint limitation
6-8	Intentionally Blank						
9-12	There are universal principles and elements of design.	How are designs influenced by universal principles and elements of design?	3.5.9-12.Q Implement and critique principles, elements, and factors of design.	**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 trade-off considerations.	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. 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.	line shape space value form texture color balance rhythm pattern emphasis contrast unity movement

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K-2	Intentionally Blank						
3-5	Intentionally Blank						
6-8	Intentionally Blank						
9-12	Making is an inherent part of technology and engineering design.	Why is making a necessary component of design?	3.5.9-12.AA Safely apply an appropriate range of making skills to a design thinking process.	**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 ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Both physical models and computers can be used in various ways to aid in the engineering design process. 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.	safe skill making design thinking

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K-2	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	3.5.K-2.S Apply design concepts, principles, and processes through play and exploration.	**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.	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.	apply explore requirements
	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	3.5.K-2.T Demonstrate that designs have requirements.	**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.	Before beginning to design a solution, it is important to clearly understand the problem.	**Making and Doing** Learns to use tools and materials to accomplish a task. **Critical Thinking** Engages in listening, questioning, and discussing.	requirements
3-5	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	3.5.3-5.O Describe requirements of designing or making a product or system.	**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.	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. 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. Different solutions need to be tested in order to determine which of them best	**Communication** Develops written and oral communication skills.	constraint criteria optimization

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					solves the problem, given the criteria and the constraints.		
	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	[3.5.3-5.T](3.5.3-5.T) Apply universal principles and elements of design.	**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.	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. 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. 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.	constraint criteria optimization
	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	[3.5.3-5.U](3.5.3-5.U) Evaluate designs based on criteria, constraints, and standards.	**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.	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. **Critical Thinking** Knows how to find answers to technological questions.	constraint criteria optimization

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6-8	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	[3.5.6-8.U] Evaluate and assess the strengths and weaknesses of various design solutions given established principles and elements of design.	**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.	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. 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.	design principle design element evaluate strength weakness design solution articulate effectiveness
	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	[3.5.6-8.V] Refine design solutions to address criteria and constraints.	**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.	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** Exhibits safe, effective ways of producing technological products, systems, and processes. **Optimism** Critiques technological products and systems to identify areas of improvement.	criteria constraint optimize
	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	[3.5.6-8.W (ETS)] 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.	**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.	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.	precision scientific principles impacts natural environment

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9-12	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	3.5.9-12.S Conduct research to inform intentional inventions and innovations that address specific needs and wants.	**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.	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.	making research invention innovation need want
	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	3.5.9-12.T (ETS) Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	**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.	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.	qualitative quantitative societal needs societal wants
	Design optimization is driven by criteria and constraints.	How do criteria and constraints drive design?	3.5.9-12.W Optimize a design by addressing desired qualities within criteria and constraints while considering trade-offs.	**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 trade-off considerations.	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.	making criteria constraint optimal optimize approach solution trade-off