Technology & Engineering Curriculum Framework

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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 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** 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 it meets 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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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.	**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.	**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.	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, computational, and/or algorithmic representations of	**Optimism** Shows persistence in addressing technological problems and finding solutions to those problems.	invention innovation diffusion interdisciplinary

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					phenomena or design solutions to describe and/or support claims and/or explanations.		

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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

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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.	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. 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.	**Making and Doing** Demonstrates the ability to regulate and improve making and doing skills.	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.	Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. 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
	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.	**HS-ESS3-3** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. **NAEP D.12.17** 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. **ISTE 1D** 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.	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. 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.	Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	**Communication** Learns that humans have many ways to communicate.	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.	**Optimism** Sees opportunities for making technologies better. **Attention to Ethics** Learns that use of technology affects humans and the environment.	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.	**N/A**	**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.	**Making and Doing** Safely uses grade-appropriate tools, materials, and processes to build projects.	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	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	**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

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.	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. 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.	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.	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. 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.	**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.	Information Age processing exchange data information

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.	**Making and Doing** Exhibits safe, effective ways of producing technological products, systems, and processes. **Attention to Ethics** Shows an understanding of ways to regulate technologies and the reasons for doing so.	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.	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. 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.	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. 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
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.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.	**N/A**	**Communication** Develops written and oral communication skills.	property application
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.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.	**Communication** Develops written and oral communication skills.	material capital resource

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	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.	adapt advancement

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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	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.	**Making and Doing** Demonstrates the ability to regulate and improve making and doing skills.	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.	**Making and Doing** Demonstrates the ability to regulate and improve making and doing skills.	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.	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. 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.	community development design

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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.	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	**Optimism** Sees opportunities for making technologies better. **Attention to Ethics** Learns that use of technology affects humans and the environment.	illustrate solution design want need plausible
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.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.	**Communication** Develops written and oral communication skills.	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.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.	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the 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.	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. 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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Strand: Design in Technology & Engineering Education							
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.	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. 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.	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. 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,	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**
				prioritized criteria, and trade-off considerations.			

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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	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.	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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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	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.	**N/A**	**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.	**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**	**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.	solution constraint limitation

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					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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	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.	**N/A**	**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.	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	**Making and Doing** Exhibits safe, effective ways of producing technological products, systems, and processes.	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.	Apply scientific principles to design a method for monitoring and minimizing human impact on the environment. 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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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.	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 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. 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.	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. 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.	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.	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.	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	**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.	**Critical Thinking** Knows how to find answers to technological questions.	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.	**Attention to Ethics** Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.	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.	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 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 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.	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.	**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.	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	**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
9-12	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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	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.	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal need and wants.	**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.	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.	**Making and Doing** Demonstrates the ability to regulate and improve making and doing skills.	making criteria constraint optimal optimize approach solution trade-off