

Indiana Academic Standards Science



Grade 4

K-12 Science Indiana Academic Standards Overview

The K-12 Science Indiana Academic Standards are based on *A Framework for K-12 Science Education* (NRC, 2012) and the Next Generation Science Standards (NGSS Lead States, 2013). They are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The K-12 Science Indiana Academic Standards:

- Reflect science as it is practiced and experienced in the real world;
- Build logically from kindergarten through grade 12;
- Focus on deeper understanding as well as application of content; and
- Integrate practices, crosscutting concepts, and core ideas.

The K-12 Science Indiana Academic Standards outline the knowledge, science, and engineering practices that all students should learn by the end of high school. The standards are three-dimensional because each student performance expectation engages students at the nexus of the following three dimensions:

- Dimension 1 describes scientific and engineering practices.
- Dimension 2 describes crosscutting concepts, overarching science concepts that apply across science disciplines.
- Dimension 3 describes core ideas in the science disciplines.

Science and Engineering Practices (*as found in NGSS*)

The eight practices describe what scientists use to investigate and build models and theories of the world around them or that engineers use as they build and design systems. The practices are essential for all students to learn and are as follows:

1. Asking questions (for science) and defining problems (for engineering);
2. Developing and using models;
3. Planning and carrying out investigations;
4. Analyzing and interpreting data;
5. Using mathematics and computational thinking;
6. Constructing explanations for science and designing solutions for engineering;
7. Engaging in argument from evidence; and
8. Obtaining, evaluating, and communicating information.

Crosscutting Concepts (*as found in NGSS*)

The seven crosscutting concepts bridge disciplinary boundaries and unit core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas, and develop a coherent, and scientifically based view of the world. The seven crosscutting concepts are as follows:

1. *Patterns*. Observed patterns of forms and events guide organization and classification, and prompt questions about relationships and the factors that influence them.
2. *Cause and Effect: Mechanism and Explanation*. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated.

Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

3. *Scale, Proportion, and Quantity*. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
4. *Systems and System Models*. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
5. *Energy and Matter: Flows, Cycles, and Conservation*. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
6. *Structure and Function*. The way in which an object or living thing is shaped and its substructure determines many of its properties and functions.
7. *Stability and Change*. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Disciplinary Core Ideas (as found in NGSS)

The disciplinary core ideas describe the content that occurs at each grade or course. The K-12 Science Indiana Academic Standards focus on a limited number of core ideas in science and engineering both within and across the disciplines and are built on the notion of learning as a developmental progression. The Disciplinary Core Ideas are grouped into the following domains:

- Physical Science (PS)
- Life Science (LS)
- Earth and Space Science (ESS)
- Engineering, Technology and Applications of Science (ETS)

The K-12 Science Indiana Academic Standards are not intended to be used as curriculum. Instead, the standards are the minimum that students should know and be able to do. Therefore, teachers should continue to differentiate for the needs of their students by adding depth and additional rigor.

References:

- National Research Council. 2012. *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/13165>.
- NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

How to Read the Revised Science Indiana Academic Standards

Standard Number	Title
<p>The title for a set of performance expectations is not necessarily unique and may be reused at several different grade levels.</p>	
<p>Students who demonstrate understanding can:</p>	
<p>Standard Number</p>	<p>Performance Expectation: A statement that combines practices, core ideas, and crosscutting concepts together to describe how students can show what they have learned. [Clarification Statement: A statement that supplies examples or additional clarification to the performance expectation.]</p>
<p>Science and Engineering Practices</p> <p>Science and Engineering Practices are activities that scientists and engineers engage in to either understand the world or solve the problem.</p> <p>There are 8 practices. These are integrated into each standard. They were previously found at the beginning of each grade level content standard and known as SEPs.</p> <p>Connections to the Nature of Science</p> <p>Connections are listed in either practices or the crosscutting concepts section.</p>	<p>Disciplinary Core Ideas</p> <p>Disciplinary Core Ideas are concepts in science and engineering that have broad importance within and across disciplines as well as relevance in people’s lives.</p> <p>To be considered core, the ideas should meet at least two of the following criteria and ideally all four:</p> <ul style="list-style-type: none"> ● Have broad importance across multiple sciences or engineering disciplines or be a key organizing concept of a single discipline. ● Provide a key tool for understanding or investigating more complex ideas and solving problems. ● Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge. ● Be teachable and learnable over multiple grades at increasing levels of depth and sophistication. <p>Disciplinary ideas are grouped in four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology, and applications of science.</p> <p>Crosscutting Concepts</p> <p>Crosscutting concepts are seven ideas such as Patterns and Cause and Effect, which are not specific to any one discipline but cut across them all.</p> <p>Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas.</p> <p>Connections to Engineering, Technology and Applications of Science</p> <p>These connections are drawn from either the Disciplinary Core Ideas or Science and Engineering Practices.</p>

4-PS3-1 Energy	
<p>Students who demonstrate understanding can:</p> <p>4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.</p>	
<p style="text-align: center;">Science and Engineering Practices</p> <p>SEP.6: Constructing Explanations and Designing Solutions</p> <p>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.</p> <ul style="list-style-type: none"> Use evidence (e.g., measurements, observations, patterns) to construct an explanation. 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> The faster a given object is moving, the more energy it possesses.
	<p style="text-align: center;">Crosscutting Concepts</p> <p>CC.5: Energy and Matter</p> <ul style="list-style-type: none"> Energy can be transferred in various ways and between objects.

4-PS3-2 Energy	
<p>Students who demonstrate understanding can:</p> <p>4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</p>	
<p style="text-align: center;">Science and Engineering Practices</p> <p>SEP.3: Planning and Carrying Out Investigations</p> <p>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.</p> <ul style="list-style-type: none"> Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> Energy can be moved from place to place by moving objects or through sound, light, or electric currents. <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated, and sound is produced. Light also transfers energy from place to place. Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.
	<p style="text-align: center;">Crosscutting Concepts</p> <p>CC.5: Energy and Matter</p> <ul style="list-style-type: none"> Energy can be transferred in various ways and between objects.

4-PS3-3 Energy	
<p>Students who demonstrate understanding can:</p> <p>4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide. [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.]</p>	
<p style="text-align: center;">Science and Engineering Practices</p> <p>SEP.1: Asking Questions and Defining Problems</p> <p>Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> Energy can be moved from place to place by moving objects or through sound, light, or electric currents. <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated, and sound is produced. <p>PS3.C: Relationship Between Energy and Forces</p> <ul style="list-style-type: none"> When objects collide, the contact forces transfer energy so as to change the objects' motions.
	<p style="text-align: center;">Crosscutting Concepts</p> <p>CC.5: Energy and Matter</p> <ul style="list-style-type: none"> Energy can be transferred in various ways and between objects.

4-PS3-4 Energy	
<p>Students who demonstrate understanding can:</p> <p>4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.]</p>	
<p style="text-align: center;">Science and Engineering Practices</p> <p>SEP.6: Constructing Explanations and Designing Solutions</p> <p>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.</p> <ul style="list-style-type: none"> Apply scientific ideas to solve design problems. 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. <p>PS3.D: Energy in Chemical Processes and Everyday Life</p> <ul style="list-style-type: none"> The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. <p>ETS1.A: Defining Engineering Problems</p> <ul style="list-style-type: none"> 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. (<i>secondary</i>)
	<p style="text-align: center;">Crosscutting Concepts</p> <p>CC.5: Energy and Matter</p> <ul style="list-style-type: none"> Energy can be transferred in various ways and between objects. <p style="text-align: center;">-----</p> <p style="text-align: center;">Connections to Engineering, Technology, and Applications of Science</p> <p>Influence of Engineering, Technology, and Science on Society and the Natural World</p> <ul style="list-style-type: none"> Engineers improve existing technologies or develop new ones. <p style="text-align: center;">-----</p> <p style="text-align: center;">Connections to Nature of Science</p> <p>Science is a Human Endeavor</p> <ul style="list-style-type: none"> Most scientists and engineers work in teams. Science affects everyday life.

4-PS4-1 Waves and Their Applications in Technologies for Information Transfer	
<p>Students who demonstrate understanding can:</p> <p>4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.]</p>	
<p style="background-color: #3f51b5; color: white; padding: 2px; text-align: center;">Science and Engineering Practices</p> <p>SEP.2: Developing and Using Models</p> <p>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.</p> <ul style="list-style-type: none"> Develop a model using an analogy, example, or abstract representation to describe a scientific principle. <p style="text-align: center;">-----</p> <p style="text-align: center;"><i>Connections to Nature of Science</i></p> <p>Scientific Knowledge is Based on Empirical Evidence</p> <ul style="list-style-type: none"> Science findings are based on recognizing patterns. 	<p style="background-color: #ff9800; color: white; padding: 2px; text-align: center;">Disciplinary Core Ideas</p> <p>PS4.A: Wave Properties</p> <ul style="list-style-type: none"> Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (<i>Note: This grade band endpoint was moved from K–2.</i>) Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).
	<p style="background-color: #4caf50; color: white; padding: 2px; text-align: center;">Crosscutting Concepts</p> <p>CC.1: Patterns</p> <ul style="list-style-type: none"> Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.

4-PS4-2 Waves and Their Applications in Technologies for Information Transfer	
<p>Students who demonstrate understanding can:</p> <p>4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.</p>	
<p style="background-color: #3f51b5; color: white; padding: 2px; text-align: center;">Science and Engineering Practices</p> <p>SEP.2: Developing and Using Models</p> <p>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.</p> <ul style="list-style-type: none"> Develop a model to describe phenomena. 	<p style="background-color: #ff9800; color: white; padding: 2px; text-align: center;">Disciplinary Core Ideas</p> <p>PS4.B: Electromagnetic Radiation</p> <ul style="list-style-type: none"> An object can be seen when light reflected from its surface enters the eyes.
	<p style="background-color: #4caf50; color: white; padding: 2px; text-align: center;">Crosscutting Concepts</p> <p>CC.2: Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships are routinely identified.

4-PS4-3 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

- 4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.**
 [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

Science and Engineering Practices

SEP.6: Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Disciplinary Core Ideas

PS4.C: Information Technologies and Instrumentation

- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.

ETS1.C: Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (*secondary*)

Crosscutting Concepts

CC.1: Patterns

- Similarities and differences in patterns can be used to sort and classify designed products.

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering.

4-PS2-1 Motion and Stability: Forces and Interactions	
<p>Students who demonstrate understanding can:</p> <p>4-PS2-1.* Investigate how multiple simple machines work together to perform everyday tasks.</p>	
<p style="background-color: #4b0082; color: white; padding: 2px;">Science and Engineering Practices</p> <p>SEP.3: Planning and Carrying Out Investigations</p> <p>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.</p> <ul style="list-style-type: none"> 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. <p style="text-align: center;">-----</p> <p style="text-align: center;"><i>Connections to Nature of Science</i></p> <p>Scientific Investigations Use a Variety of Methods</p> <ul style="list-style-type: none"> Science investigations use a variety of methods, tools, and techniques. 	<p style="background-color: #ff8c00; color: white; padding: 2px;">Disciplinary Core Ideas</p> <p>PS2.A: Forces and Motion</p> <ul style="list-style-type: none"> Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object’s speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) <p>PS2.B: Types of Interactions</p> <ul style="list-style-type: none"> Objects in contact exert forces on each other.
	<p style="background-color: #76b82a; color: white; padding: 2px;">Crosscutting Concepts</p> <p>CC.2: Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships are routinely identified.

4-LS1-1 From Molecules to Organisms: Structures and Processes	
<p>Students who demonstrate understanding can:</p> <p>4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.]</p>	
<p style="background-color: #4b0082; color: white; padding: 2px;">Science and Engineering Practices</p> <p>SEP.7: Engaging in Argument from Evidence</p> <p>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).</p> <ul style="list-style-type: none"> Construct an argument with evidence, data, and/or a model. 	<p style="background-color: #ff8c00; color: white; padding: 2px;">Disciplinary Core Ideas</p> <p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
	<p style="background-color: #76b82a; color: white; padding: 2px;">Crosscutting Concepts</p> <p>CC.4: Systems and System Models</p> <ul style="list-style-type: none"> A system can be described in terms of its components and their interactions.

4-LS1-2 From Molecules to Organisms: Structures and Processes	
<p>Students who demonstrate understanding can:</p> <p>4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. [Clarification Statement: Emphasis is on systems of information transfer.]</p>	
<p style="text-align: center;">Science and Engineering Practices</p> <p>SEP.2: Developing and Using Models</p> <p>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.</p> <ul style="list-style-type: none"> Use a model to test interactions concerning the functioning of a natural system. 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>LS1.D: Information Processing</p> <ul style="list-style-type: none"> Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.
	<p style="text-align: center;">Crosscutting Concepts</p> <p>CC.4: Systems and System Models</p> <ul style="list-style-type: none"> A system can be described in terms of its components and their interactions.

4-ESS1-1 Earth's Place in the Universe	
<p>Students who demonstrate understanding can:</p> <p>4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.]</p>	
<p style="text-align: center;">Science and Engineering Practices</p> <p>SEP.6: Constructing Explanations and Designing Solutions</p> <p>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.</p> <ul style="list-style-type: none"> Identify the evidence that supports particular points in an explanation. 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>ESS1.C: The History of Planet Earth</p> <ul style="list-style-type: none"> Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.
	<p style="text-align: center;">Crosscutting Concepts</p> <p>CC.1: Patterns</p> <ul style="list-style-type: none"> Patterns can be used as evidence to support an explanation. <p style="text-align: center;">-----</p> <p style="text-align: center;">Connections to Nature of Science</p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</p> <ul style="list-style-type: none"> Science assumes consistent patterns in natural systems.

4-ESS2-1 Earth's Systems	
<p>Students who demonstrate understanding can:</p> <p>4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.]</p>	
<p style="text-align: center;">Science and Engineering Practices</p> <p>SEP.3: Planning and Carrying Out Investigations</p> <p>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.</p> <ul style="list-style-type: none"> ● Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>ESS2.A: Earth Materials and Systems</p> <ul style="list-style-type: none"> ● Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. <p>ESS2.E: Biogeology</p> <ul style="list-style-type: none"> ● Living things affect the physical characteristics of their regions.
	<p style="text-align: center;">Crosscutting Concepts</p> <p>CC.2: Cause and Effect</p> <ul style="list-style-type: none"> ● Cause and effect relationships are routinely identified, tested, and used to explain change.

4-ESS2-2 Earth's Systems	
<p>Students who demonstrate understanding can:</p> <p>4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]</p>	
<p style="text-align: center;">Science and Engineering Practices</p> <p>SEP.4: Analyzing and Interpreting Data</p> <p>Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</p> <ul style="list-style-type: none"> Analyze and interpret data to make sense of phenomena using logical reasoning. 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>ESS2.B: Plate Tectonics and Large-Scale System Interactions</p> <ul style="list-style-type: none"> The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.
	<p style="text-align: center;">Crosscutting Concepts</p> <p>CC.1: Patterns</p> <ul style="list-style-type: none"> Patterns can be used as evidence to support an explanation.

4-ESS3-1 Earth and Human Activity	
<p>Students who demonstrate understanding can:</p> <p>4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. <i>[Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]</i></p>	
<p style="background-color: #4b4b9b; color: white; padding: 2px;">Science and Engineering Practices</p> <p>SEP.8: Obtaining, Evaluating, and Communicating Information</p> <p>Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> Obtain and combine information from books and other reliable media to explain phenomena. 	<p style="background-color: #e69a00; color: white; padding: 2px; text-align: center;">Disciplinary Core Ideas</p> <p>ESS3.A: Natural Resources</p> <ul style="list-style-type: none"> Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.
	<p style="background-color: #7ebc4b; color: white; padding: 2px; text-align: center;">Crosscutting Concepts</p> <p>CC.2: Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships are routinely identified and used to explain change. <p style="text-align: center;">-----</p> <p style="text-align: center;"><i>Connections to Engineering, Technology, and Applications of Science</i></p> <p>Interdependence of Science, Engineering, and Technology</p> <ul style="list-style-type: none"> Knowledge of relevant scientific concepts and research findings is important in engineering. <p>Influence of Engineering, Technology, and Science on Society and the Natural World</p> <ul style="list-style-type: none"> Over time, people’s needs and wants change, as do their demands for new and improved technologies.

4-ESS3-2 Earth and Human Activity	
<p>Students who demonstrate understanding can:</p> <p>4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. <i>[Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.]</i></p>	
<p style="text-align: center;">Science and Engineering Practices</p> <p>SEP.6: Constructing Explanations and Designing Solutions</p> <p>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.</p> <ul style="list-style-type: none"> ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>ESS3.B: Natural Hazards</p> <ul style="list-style-type: none"> ● A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. <i>(Note: This Disciplinary Core Idea can also be found in 3.WC.)</i> <p>ETS1.B: Designing Solutions to Engineering Problems</p> <ul style="list-style-type: none"> ● Testing a solution involves investigating how well it performs under a range of likely conditions. <i>(secondary)</i>
	<p style="text-align: center;">Crosscutting Concepts</p> <p>CC.2: Cause and Effect</p> <ul style="list-style-type: none"> ● Cause and effect relationships are routinely identified, tested, and used to explain change. <p style="text-align: center;">-----</p> <p style="text-align: center;"><i>Connections to Engineering, Technology, and Applications of Science</i></p> <p>Influence of Engineering, Technology, and Science on Society and the Natural World</p> <ul style="list-style-type: none"> ● Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands.

3-5-ETS1-1 Engineering Design	
<p>Students who demonstrate understanding can:</p> <p>3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</p>	
<p style="background-color: #000080; color: white; padding: 2px;">Science and Engineering Practices</p> <p>SEP.1: Asking Questions and Defining Problems</p> <p>Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. 	<p style="background-color: #ff8c00; color: white; padding: 2px;">Disciplinary Core Ideas</p> <p>ETS1.A: Defining and Delimiting Engineering Problems</p> <ul style="list-style-type: none"> 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.
	<p style="background-color: #76b82a; color: white; padding: 2px;">Crosscutting Concepts</p> <p><i>Connections to Engineering, Technology, and Applications of Science</i></p> <p>Influence of Science, Engineering, and Technology on Society and the Natural World</p> <ul style="list-style-type: none"> People’s needs and wants change over time, as do their demands for new and improved technologies.

3-5-ETS1-2 Engineering Design	
<p>Students who demonstrate understanding can:</p> <p>3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</p>	
<p style="background-color: #333399; color: white; padding: 2px;">Science and Engineering Practices</p> <p>SEP.6: Constructing Explanations and Designing Solutions</p> <p>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.</p> <ul style="list-style-type: none"> ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. 	<p style="background-color: #ff9933; color: white; padding: 2px;">Disciplinary Core Ideas</p> <p>ETS1.B: Developing Possible Solutions</p> <ul style="list-style-type: none"> ● 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.
	<p style="background-color: #99cc66; color: white; padding: 2px;">Crosscutting Concepts</p> <p style="text-align: center;"><i>Connections to Engineering, Technology, and Applications of Science</i></p> <p style="text-align: center;">Influence of Science, Engineering, and Technology on Society and the Natural World</p> <ul style="list-style-type: none"> ● Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

3-5-ETS1-3 Engineering Design	
<p>Students who demonstrate understanding can:</p> <p>3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</p>	
<p style="background-color: #333399; color: white; padding: 2px;">Science and Engineering Practices</p> <p>SEP.3: Planning and Carrying Out Investigations</p> <p>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.</p> <ul style="list-style-type: none"> ● 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. 	<p style="background-color: #ff9933; color: white; padding: 2px;">Disciplinary Core Ideas</p> <p>ETS1.B: Developing Possible Solutions</p> <ul style="list-style-type: none"> ● Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. <p>ETS1.C: Optimizing the Design Solution</p> <ul style="list-style-type: none"> ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.