INTRODUCTION TO PERFORMANCE EXPECTATIONS

"The NGSS are standards or goals, that reflect what a student should know and be able to do; they do not dictate the manner or methods by which the standards are taught. . . . Curriculum and assessment must be developed in a way that builds students' knowledge and ability toward the PEs [performance expectations]" (Next Generation Science Standards, 2013, page xiv).

This chapter shows how the NGSS Performance Expectations were bundled in the **Weather and Water Course** to provide a coherent set of instructional materials for teaching and learning.

This chapter also provides details about how this FOSS course fits into the matrix of the FOSS Program (page 51). Each FOSS module K–5 and middle school course 6–8 has a functional role in the FOSS conceptual frameworks that were developed based on a decade of research on science education and the influence of *A Framework for K–12 Science Education* (2012) and *Next Generation Science Standards* (NGSS, 2013).

The FOSS curriculum provides a coherent vision of science teaching and learning in the three ways described by the NRC *Framework*. First, FOSS is designed around learning as a developmental progression, providing experiences that allow students to continually build on their initial notions and develop more complex science and engineering knowledge. Students develop functional understanding over time by building on foundational elements (intermediate knowledge). That progression is detailed in the conceptual frameworks.

Second, FOSS limits the number of core ideas, choosing depth of knowledge over broad shallow coverage. Those core ideas are addressed at multiple grade levels in ever greater complexity. FOSS investigations at each grade level focus on elements of core ideas that are teachable and learnable at that grade level.

Third, FOSS investigations integrate engagement with scientific ideas (content) and the practices of science and engineering by providing firsthand experiences.

Teach the course with the confidence that the developers have carefully considered the latest research and have integrated into each investigation the three dimensions of the NRC *Framework* and NGSS, and have designed powerful connections to the Common Core State Standards for English Language Arts.

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DISCIPLINARY CORE IDEAS

A Framework for K–12 Science Education has three core ideas in Earth and space sciences.

ESS1: Earth's place in the universe

ESS2: Earth's systems

ESS3: Earth and human activity

The questions and descriptions of the core ideas in the text on these pages are taken from the NRC *Framework* for grades 6–8 to keep the core ideas in a rich and useful context.

The performance expectations related to each core idea are taken from the NGSS for grades 6–8.

Disciplinary Core Ideas Addressed

The **Weather and Water Course** connects with the NRC *Framework* grades 6–8 grade band and the NGSS performance expectations for the middle school grades.

Earth and Space Sciences

Framework core idea ESS1: Earth's place in the universe—What is the universe, and what is Earth's place in it?

- **ESS1.B: Earth and the solar system**
  What are the predictable patterns caused by Earth's movement in the solar system? [Earth's spin axis is fixed in direction over the short term but tilted relative to its orbit around the Sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.]

The following NGSS grade 6 performance expectation for ESS1 is derived from the Framework disciplinary core idea above.

- **MS-ESS1-1.** Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]

Framework core idea ESS2: Earth's systems—How and why is Earth constantly changing?

- **ESS2.C: The roles of water in Earth's surface processes**
  How do the properties and movements of water shape Earth's surface and affect its systems? [Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation as well as downhill flows on land. The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. Global movements of water and its changes in form are propelled by sunlight and gravity. Variations in density due to variation in temperature and salinity drive a global pattern of interconnected ocean currents. Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.]

- **ESS2.D: Weather and climate**
  What regulates weather and climate? [Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography,

all of which can affect oceanic and atmospheric flow patterns. Because these patterns are so complex, weather can be predicted only probabilistically. The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. Greenhouse gases in the atmosphere absorb and retain the energy radiated from land and ocean surfaces, thereby regulating Earth's average surface temperature and keeping it habitable.]

The following NGSS grade 6 performance expectations for ESS2 are derived from the Framework disciplinary core ideas above.

- **MS-ESS2-4.** Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]
- **MS-ESS2-5.** Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]
- **MS-ESS2-6.** Develop and use a model to describe how unequal heating and rotation of Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]

REFERENCES

National Research Council. *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Washington, DC: National Academies Press, 2012.

NGSS Lead States. *Next Generation Science Standards: For States, by States.* Washington, DC: National Academies Press, 2013.

National Governors Association Center for Best Practices and Council of Chief State School Officers. *Common Core State Standards for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects*. Washington, DC: authors, 2010.

Framework core idea ESS3: Earth and human activity—How do Earth's surface processes and human activities affect each other?

- **ESS3.B: Natural hazards**
  How do natural hazards affect individuals and societies? [Some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions. Others, such as earthquakes, occur suddenly and with no notice, and thus they are not yet predictable. However, mapping the history of natural hazards in a region, combined with an understanding of related geological forces can help forecast the locations and likelihoods of future events.]

- **ESS3.C: Human impacts on Earth systems**
  How do humans change the planet? [Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of many other species. But changes to Earth's environments can have different impacts (negative and/or positive) for different living things. Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.]

- **ESS3.D: Global climate change**
  How do people model and predict the effects of human activities on Earth's climate? [Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing human vulnerability to whatever climate changes do occur depends on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.]

The following NGSS grade 6 performance expectations for ESS3 are derived from the Framework disciplinary core ideas above.

- **MS-ESS3-2.** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

- **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]
- **MS-ESS3-4.** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]
- **MS-ESS3-5.** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

Physical Sciences

Framework core idea PS1: Matter and its interactions—How can one explain the structure, properties, and interactions of matter?

- **PS1.A: Structure and properties of matter**
  How do particles combine to form the variety of matter one observes?
  [Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. In a liquid, the molecules

DISCIPLINARY CORE IDEAS

A Framework for K–12 Science Education has four core ideas in physical sciences.

PS1: Matter and its interactions

PS2: Motion and stability: Forces and interactions

PS3: Energy

PS4: Waves and their applications in technologies for information transfer

The questions and descriptions of the core ideas in the text on these pages are taken from the NRC *Framework* for grades 6–8 to keep the core ideas in a rich and useful context.

The performance expectations related to each core idea are taken from the NGSS for grades 6–8.

are constantly in contact with each other; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and vibrate in position but do not change relative locations. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.]

The following NGSS grade 6 performance expectation for PS1 is derived from the Framework disciplinary core idea above.

- **MS-PS1-4.** Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

Framework core idea PS3: Energy—How is energy transferred and conserved?

- **PS3.A: Definitions of energy**
  What is energy? [The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and energy transfers by convection, conduction, and radiation (particularly infrared and light). In science, heat is used only for this second meaning; it refers to energy transferred when two objects or systems are at different temperatures. Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.]

- **PS3.B: Conservation of energy and energy transfer**
  What is meant by conservation of energy? How is energy transferred between objects or systems? [The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. Energy is transferred out of hotter regions or objects and into colder ones by the processes of conduction, convection, and radiation.]

The following NGSS grade 6 performance expectations for PS3 are derived from the Framework disciplinary core ideas above.

- **MS-PS3-3.** Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]
- **MS-PS3-4.** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]
- **MS-PS3-5.** Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object. [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

Engineering, Technology, and Applications of Science

Framework core idea ETS1: Engineering design—How do engineers solve problems?

- **ETS1.A: Defining and delimiting an engineering problem**
  What is a design for? What are the criteria and constraints of a successful solution? [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 (e.g., familiarity with the local climate may rule out certain plants for the school garden).]
- **ETS1.B: Developing possible solutions**
  What is the process for developing potential design solutions? [A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes

DISCIPLINARY CORE IDEAS

A Framework for K–12 Science Education has two core ideas in engineering, technology, and applications of science.

ETS1: Engineering design

ETS2: Links among engineering, technology, science, and society

The questions and descriptions of the core ideas in the text on these pages are taken from the NRC *Framework* for grades 6–8 to keep the core ideas in a rich and useful context.

The performance expectations related to each core idea are taken from the NGSS for grades 6–8.

for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. In any case, it is important to be able to communicate and explain solutions to others. Models of all kinds are important for testing solutions, and computers are a valuable tool for simulating systems. Simulations are useful for predicting what would happen if various parameters of the model were changed, as well as for making improvements to the model based on peer and leader (e.g., teacher) feedback.]

- **ETS1.C: Optimizing the design solution**
  How can the various proposed design solutions be compared and improved? [There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Comparing different designs could involve running them through the same kinds of tests and systematically recording the results to determine which design performs best. Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. This 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. Once such a suitable solution is determined, it is important to describe that solution, explain how it was developed, and describe the features that make it successful.]

The following NGSS grade 6 performance expectations for ETS1 are derived from the Framework disciplinary core ideas above.

- **MS-ETS1-1.** 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.
- **MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- **MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- **MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

CONNECTIONS

See volume 2, appendix H and appendix J, in the NGSS for more on these connections.

Connections to the Nature of Science

- **Scientific investigations use a variety of methods.** Scientific investigations are guided by a set of values to ensure accuracy of measurements, observations, and objectivity of findings. Science depends on evaluating proposed explanations.
- **Scientific knowledge is based on empirical evidence.** Scientific knowledge is based on logical and conceptual connections between evidence and explanations. Science disciplines share common rules of obtaining and evaluating empirical evidence.
- **Science is a way of knowing.** Science is both a body of knowledge and processes and practices used to add to that body of knowledge. Scientific knowledge is cumulative and many people from many generations and nations have contributed to scientific knowledge (not just scientists).
- **Scientific knowledge assumes an order and consistency in natural systems.** Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. Science carefully considers and evaluates anomalies in data and evidence.
- **Science is a human endeavor.** Men and women from different social, cultural, and ethnic backgrounds work as scientists and engineers. Scientists and engineers rely on human qualities such as persistence, precision, reasoning, logic, imagination, and creativity. They are guided by habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. Advances in technology influence the progress of science, and science has influenced advances in technology.
- **Science addresses questions about the natural and material world.** Scientific knowledge is constrained by human capacity, technology, and materials. Science limits its explanations to systems that lend themselves to observation and empirical evidence. Scientific knowledge can describe consequences of actions but is not responsible for society's decisions.

Connections to Engineering, Technology, and Applications of Science

- **Interdependence of science, engineering, and technology.** Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. Science and technology drive each other forward.

SCIENCE AND ENGINEERING PRACTICES

A Framework for K–12 Science Education (National Research Council, 2012) describes eight science and engineering practices as essential elements of a K–12 science and engineering curriculum. All of these practices are incorporated into the learning experiences in the **Weather and Water Course**.

The learning progression for this dimension of the framework is addressed in *Next Generation Science Standards* (National Academies Press, 2013), volume 2, appendix F. Elements of the learning progression for practices recommended for grades 6–8 as described in the performance expectations appear after bullets below each practice.

Science and Engineering Practices Addressed

1. *Asking questions and defining problems*

- Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
- Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
- Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.
- 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.

2. *Developing and using models*

- Develop or modify a model—based on evidence—to match what happens if a variable or component of a system is changed.
- Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
- Develop and/or use a model to predict and/or describe phenomena.
- Develop a model to describe unobservable mechanisms.

3. *Planning and carrying out investigations*

- Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meets the goals of the investigation.
- Collect data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.

4. *Analyzing and interpreting data*

- Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
- Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
- Distinguish between causal and correlational relationships in data.
- Analyze and interpret data to provide evidence for phenomena.

5. *Using mathematics and computational thinking*

- Use mathematical representations to describe and/or support scientific conclusions and design solutions.
- Create algorithms to solve a problem.
- Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.

6. *Constructing explanations and designing solutions*

- Construct an explanation that includes qualitative or quantitative relationships between variables that predict and/or describe phenomena.
- Construct an explanation using models or representations.
- Construct a scientific explanation based on valid and reliable evidence.
- Apply scientific ideas, principles, and/or evidence to construct, revise, and/or use an explanation for real-world phenomena, examples, or events.
- Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process, or system.
- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.

7. *Engaging in argument from evidence*

- 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.
- Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon (or a solution to a problem).

8. *Obtaining, evaluating, and communicating information*

- 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).

- 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.
- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.
- Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.

CROSSCUTTING CONCEPTS

A Framework for K–12 Science Education describes seven crosscutting concepts as essential elements of a K–12 science and engineering curriculum. The learning progression for this dimension of the framework is addressed in volume 2, appendix G, of the NGSS. Elements of the learning progression for crosscutting concepts recommended for grades 6–8, as described in the performance expectations, appear after bullets below each concept.

Crosscutting Concepts Addressed

Patterns: *Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.*

- Patterns in rates of change and other numerical relationships can provide information about natural and human-designed systems.
- Patterns can be used to identify cause-and-effect relationships.
- Graphs, charts, and images can be used to identify patterns in data.

Cause and effect: *Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.*

- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
- Cause-and-effect relationships may be used to predict phenomena in natural or designed systems.
- Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.

Scale, proportion, and quantity: *In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.*

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Systems and system models: *A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.*

- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
- Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy, matter, and information flows within systems.
- Models are limited in that they only represent certain aspects of the system under study.

Energy and matter: *Tracking energy and matter flows into, out of, and within systems helps one understand their system's behavior.*

- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.
- The transfer of energy can be tracked as energy flows through a designed or natural system.

Structure and function: *The way an object is shaped or structured determines many of its properties and functions.*

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Stability and change: *For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of the system are critical elements of study.*

- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.
- Small changes in one part of a system might cause large changes in another part.
- Stability might be disturbed either by sudden events or gradual changes that accumulate over time.
- Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms.

FOSS CONCEPTUAL FRAMEWORK

FOSS has conceptual structure at the course level. The concepts are carefully selected and organized in a sequence that makes sense to students when presented as intended. In the last half decade, research has focused on learning progressions. The idea behind a learning progression is that **core ideas** in science are complex and wide-reaching—ideas such as the structure of matter or the relationship between the distribution and function of organisms. From the age of awareness throughout life, matter and organisms are important to us. There are things we can and should understand about them in our primary school years, and progressively more complex and sophisticated things we should know about them as we gain experience and develop our cognitive abilities. When we as educators can determine those logical progressions, we can develop meaningful and effective curriculum.

FOSS has elaborated learning progressions for core ideas in science for kindergarten through grade 8. Developing the learning progressions involves identifying successively more sophisticated ways of thinking about core ideas over multiple years. "If mastery of a core idea in a science discipline is the ultimate educational destination, then a well-designed learning progression provides a map of the routes that can be taken to reach that destination" (National Research Council, *A Framework for K–12 Science Education*, 2012, page 26).

The FOSS modules (grades K–5) and courses (grades 6–8) are organized into three domains: physical science, earth science, and life science. Each domain is subdivided into two strands, each representing a core scientific idea, as shown in the columns in the table: matter/energy and change, atmosphere and Earth/rocks and landforms, structure and function/complex systems. The sequence of modules and courses in each strand relates to the core ideas described in the national framework. Modules at the bottom of the table form the foundation in the primary grades. The core ideas develop in complexity as they proceed up the columns.

In addition to the science content framework, every course provides opportunities for students to engage in and understand science practices, and many courses explore issues related to engineering practices and the use of natural resources.

The science content used to develop the FOSS courses describes what we want students to learn; the science and engineering practices describe how we want students to learn; and crosscutting concepts stitch the whole effort into a coherent fabric describing the whole natural world. Practices involve a number of habits of mind and philosophical orientations, and these, too, will develop in richness and complexity as students advance through their science studies. Science and engineering practices involve behaviors, so they can be best assessed while in progress. Thus, assessment of practices is based on teacher observation. The indicators of progress include students involved in the many aspects of active thinking, students motivated to learn, and students taking responsibility for their own learning.

FOSS Next Generation—K–8 Sequence

	PHYSICAL SCIENCE		EARTH SCIENCE		LIFE SCIENCE	
	MATTER	ENERGY AND CHANGE	ATMOSPHERE AND EARTH	ROCKS AND LANDFORMS	STRUCTURE/ FUNCTION	COMPLEX SYSTEMS
6–8	Waves; Gravity and Kinetic Energy Chemical Interactions Electromagnetic Force		Planetary Science Earth History Weather and Water		Heredity and Adaptation Populations and Ecosystems Diversity of Life; Human Systems Interactions	
5	Mixtures and Solutions		Earth and Sun		Living Systems	
4		Energy		Soils, Rocks, and Landforms	Environments	
3	Motion and Matter		Water and Climate		Structures of Life	
2	Solids and Liquids			Pebbles, Sand, and Silt	Insects and Plants	
1		Sound and Light	Air and Weather		Plants and Animals	
K	Materials and Motion		Trees and Weather		Animals Two by Two	

BACKGROUND FOR THE CONCEPTUAL FRAMEWORK
in Weather and Water

Viewed from space, the sphere called Earth might be considered a planet of oceans and clouds with just a hint of solid rock. From this perspective we can understand why a study of Earth's physical environment is usually divided into three parts: the solid Earth, including the crust and upper mantle (lithosphere), the deep mantle, and the dense core; the gaseous atmosphere surrounding the planet; and the defining water component, the hydrosphere.

The solid portion of Earth, its crust or terra firma, provides the visible means of support for our structures—the schools, factories, skyscrapers, highways, reservoirs, swimming pools, amusement parks, and so on—in which and on which we spend our time. Solid is substantial. Solid is easy to understand.

Air is another story. We are not very conscious of the air we live in and breathe. Air provides a mostly invisible and more ethereal kind of support. Take a moment to turn your inner vision back to childhood and watch a jetliner take off. It seems like magic that such a massive thing can lift off and maintain itself in thin air. Paper airplanes skim through the air, kites hang on the wind, clouds hang seductively out of reach in the sky, and birds glide over rooftops. What's holding them up?

We are largely unaware of air. Air defines the sensory null condition—no taste, no smell, no sound, invisible, intangible. Given a gaily wrapped box of air, we might heft it, shake it, open it and peer in, give it a sniff, and proclaim that there is nothing inside. Wrong. The box is brim full . . . with air. We are conscious of air when it is windy. We can feel the force of air as it rushes by. Air becomes real, and it becomes clear that it can do work as it lifts off your hat and carries it down the street. To students, that may not be air—that's wind. These two things may need to be integrated conceptually.

Air provides the support for weather. Weather is physical conditions of the air and the interactions that take place in it. A study of Earth's weather can't happen without a closer look at the invisible layer of air called the atmosphere.

The hydrosphere is slippery, difficult to grasp, both conceptually and tangibly. The lithosphere is down here, the atmosphere is up there, but where is the hydrosphere? Part of it is easy to identify. Oceans, lakes, rivers, and swamps are clearly part of the hydrosphere because you can see masses of liquid water. But the hydrosphere

CONCEPTUAL FRAMEWORK
Earth Science
Focus on Earth's Atmosphere and Hydrosphere—Structure and Interactions
Weather and Water

Structure of Earth

Concept A The hydrosphere has properties that can be observed and quantified.

- Variations in water-solution density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.

Concept B The atmosphere has properties that can be observed and quantified.

- The density of an air mass is measured by air pressure. Air masses flow from regions of high pressure to low pressure, causing weather and wind patterns.

Earth Interactions

Concept A Weather and climate are influenced by interactions of the Sun, the ocean, the atmosphere, ice, landforms, and living things.

- Weather is the condition of Earth's atmosphere at a given time in a given place. The complex patterns of movement of water in the atmosphere, caused by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.
- Weather varies with latitude, altitude, and regional geography, all of which can affect oceanic and atmospheric flow patterns.
- The water cycle is driven by the Sun. Water cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, precipitation, and downhill flows on land.
- Energy is transferred to earth materials (air, land, water) by radiation, conduction, and convection. The Sun is the major source of energy that heats Earth. Convection currents (wind) are driven by uneven heating of Earth's surface.
- Climate is the average or typical weather expected to occur in a region, based on long-term data. Climates change over even longer periods of time.

Concept B Earth's climate and human activities affect each other.

- Mapping the history of natural hazards with knowledge of Earth processes can help to forecast future events in locations on Earth.
- If Earth's mean temperature continues to rise, organisms, including humans, will be affected in many ways. Human activities are major factors in the current rise in Earth's mean surface temperature.
- Reducing the level of climate change and reducing human vulnerability depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge.

Concept C The orbits of Earth around the Sun (and the Moon around Earth), together with the rotation of Earth about its axis between its poles, cause observable patterns.

- Seasons are a result of Earth's tilt relative to its orbit around the Sun and are caused by the differential intensity of sunlight on areas of Earth across the year.

also infiltrates both the lithosphere and the atmosphere. The invisible groundwater below and water vapor aloft are inextricably tied to the oceans, lakes, and ice caps of the world. The dynamic nature of water on Earth is one of its charming and fascinating attributes. Water pokes its molecules into everybody's business, and weather is no exception. To study weather is to understand the many characteristics of this marvelous substance.

Is It Weather or Climate?

Weather is defined as the state of the atmosphere at a given time. A description of the weather includes observations and measurements of temperature, precipitation, air pressure, and cloud cover. Weather changes from day to day and season to season.

Climate differs from weather in that it is an aggregate of weather conditions over a long time. Climate helps describe a region. Climates change, but over years or centuries, not days.

A weather report gives you information about how to plan activities for today and tomorrow. A climatologist provides information about what kinds of crops to grow and when to plant them for the next 25 years.

Meteorologists and climatologists use many of the same tools to prepare weather and climate forecasts. But each has specialized instruments as well. Meteorologists use live satellite data and current local observations, using tools such as thermometers and barometers to forecast tomorrow's weather. The climatologist accumulates seasonal and annual data for tens, hundreds, or even thousands of years. In addition to the meteorologist's thermometers and barometers, climatologists use tree-ring growth, sediment cores, pollen preserved in amber, and air bubbles trapped in ice to produce climate models. Both meteorologists and climatologists depend on supercomputers to crunch their numbers, but the meteorologist works in terms of days, while the climatologist works with scales covering centuries.

Weather as Physics, Chemistry, and Earth Science

Weather as physics. What makes weather? It all boils down to matter and energy. Matter is the stuff that makes up the universe. Energy is the ability to do work. Together, matter and energy are the basis for everything that exists and happens in the observable universe . . . including weather on Earth.

Matter in motion has kinetic energy. The faster something moves, the more kinetic energy it has. Particles are always in motion. They vibrate in solids and move all over the place in liquids and gases. In hot materials, particles are moving fast. In cold materials, they are moving more slowly. The higher the state of excitation in atoms, the more kinetic energy they possess, and the hotter the matter is.

Temperature is a measure of the average kinetic energy of atoms in a material. Knowing the temperature of different substances can tell you which has more kinetic energy. This in turn lets you predict in which direction energy will flow when two materials of different temperature are brought together. Energy always flows from warm to cold. The movement of energy from warm to cold is called energy transfer. Energy transfer occurs through radiation, conduction, and convection.

Radiation. Energy from the Sun travels through empty space as *radiation*. Electromagnetic radiation includes X-rays, ultraviolet and infrared rays, radio waves, and visible light. When an atom or molecule on Earth absorbs radiant energy, energy transfers. This added energy causes the molecules to move more. The material heats up. Energy transfer by radiation happens at a distance. The energy source and energy receiver can be far apart.

Conduction. If there are no clouds, Earth's surface receives a good dose of radiant energy, mostly in the infrared, visible, and ultraviolet wavelengths. Some of the radiation reflects back into space, but some is absorbed by molecules in Earth's surface (rock, water, vegetation, etc.). Earth's surface heats up.

Air molecules near Earth's surface may come in contact with energized molecules in Earth's surface. Energy can transfer to the air molecules. Transfer of energy from one molecule to another as a result of contact is called *conduction*. Conduction always involves transfer of energy between molecules that are in contact with each other.

Convection. When air comes in contact with a heated surface, like a concrete sidewalk, energy transfers to the air through *conduction* and radiation. Heat from the sidewalk transfers to the gas molecules. Kinetic energy of the molecules increases. Increased kinetic energy forces the molecules farther apart. The gas expands. This increases the volume of gas without increasing the number of molecules, so the gas becomes less dense.

The less dense (lighter) gas begins to rise. As it rises, the molecules cool, and the gas becomes more dense. The more dense air starts to sink. When it returns to the hot surface, it will heat up again, and the cycle will repeat. The rising of warm air and sinking of cool air is *convection*. Convection occurs only in fluids, that is, liquids and gases. Convection is usually considered the third way energy is transferred in the atmosphere. However, it might be described more accurately as energy transportation. The processes by which energy transfers from one molecule to another are radiation and conduction. Convection is the elevator that carries energized molecules up and low-energy molecules down.

Density. One property of matter is *density*. Density is defined as the ratio of a material's mass to its volume. Written as an equation,

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

All matter, whether in liquid, gaseous, or solid form, has density. Different gases have different densities. The density of gases can change. Heating a volume of gas decreases its density; cooling the gas increases its density. Increasing the pressure on a volume of gas pushes its molecules closer together, increasing its density. Decrease the pressure? The density decreases.

CONCEPTUAL FRAMEWORK
Physical Science, Focus on Matter and Energy and Change:
Weather and Water

Matter Has Structure

Concept A Matter exists in three states which have observable properties.

- Matter (solid, liquid, or gas) is made of particles too small to be seen that move relative to each other. In a gas, particles are widely spaced except when they randomly collide. Gases can be compressed.

Energy Transfer and Conservation

Concept A Energy is a quantitative property (condition) of a system that depends on the motion and interactions of matter and radiation within the system.

- Kinetic energy is energy of motion. Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total thermal energy of a system depends on the types, states, and amounts of matter present.
- The changes of state that occur with variations in temperature or pressure can be described and predicted using models of matter.

Concept B The total change of energy in any system is always equal to the total energy transferred into or out of the system. When two objects interact, each one exerts a force on the other, and these forces can transfer energy.

- When objects or particles collide, energy can transfer from one object to another, thereby changing their motion. Energy is transferred by conduction, radiation, and convection.
- Energy transfers from hotter regions or objects into colder regions.

The density of atmospheric gases and the conditions that affect density will be investigated in considerable depth. Gas density is one of the pivotal concepts in the study and understanding of weather.

Weather as chemistry. Chemistry deals with the properties, composition, and structure of elements and compounds, how they change, and the energy that chemical reactions release or absorb. Physics and chemistry are intertwined in the study of the atmosphere.

Early Greek philosophers proposed that everything on Earth was made of four elements: fire, air, earth, and water. Galileo Galilei (1564–1642) was the first person to actually weigh air. He demonstrated that anything traveling through air meets resistance, or is pushed back. About the same time, individual gases in air began to be identified. The first was carbon dioxide. It was discovered by a Belgian scientist, Jan Baptista van Helmont (1579–1644). He observed that the substance given off by burning charcoal was the same as that produced by the fermentation of grape juice. He called this gas *spiritus sylvestre*, which means "wild spirit."

Chemical studies of the atmosphere today focus on changes in the atmosphere caused by human influence. The increase in greenhouse gases such as carbon dioxide, the effects of acid rain, and the problems of air pollution in general all involve chemical methods and study.

Weather as earth science. Earth materials, that is, water, water vapor, and other atmospheric gases, rock, and soil, are the ingredients in the stew we call weather. Energy from the Sun might be considered the fire used to cook up Earth's unique version of weather. These ideas bring us back to the domain of earth science.

Earth is a planet of contrasting weather—freezing cold at the poles, hot and humid around the equator, and variations on the theme in the latitudes between. The mechanics of Earth in its orbit around the Sun cause wide variation in the amount of energy that reaches any given location over the course of a day or a year.

Earth's axis of rotation is an imaginary axle that passes through both the North and South Poles. This axis tilts at an angle of 23.5° from the plane of Earth's orbit around the Sun. And the most important bit of information is that the North Pole always points to the North Star. Always. No matter where Earth is in its orbit around the Sun, the North Pole always points to the North Star. The Sun's light spreads across the surface of the planet, resulting in differing solar angles and, as a result, uneven heating. This effect is noticeable to us if we consider the difference between hours of daylight and average temperature at locations on Earth at different latitudes—seasons.

Another factor involved in weather is differential heating. Different earth materials heat to different temperatures with the same amount of radiation from the Sun. It takes five times as much heat to raise a mass of water by 1 degree as the same mass of granite. Water also retains heat longer than other materials. This differential heating produces wind.

Engineering Design

Science is a discovery activity, a process for producing new knowledge. Scientific knowledge advances when scientists observe objects and events, think about how their observations relate to what is known, test their ideas in logical ways, and generate explanations that integrate the new information into understanding of the natural world. Thus the scientific enterprise is both what we know (content knowledge) and how we come to know it (practices). Scientists engage in a set of practices as they do their work, and these are the same practices students use in their science investigations.

Engineers apply that understanding of the natural world to solve real-world problems. Engineering is the systematic approach to finding solutions to problems identified by people in societies. The fields of science and engineering are mutually supportive, and scientists and engineers collaborate in their work. Often, acquiring scientific data requires designing and producing new technologies—tools, instruments, machines, and processes—to perform specific functions. The practices that engineers use are very similar to science practices, but also involve defining problems and designing solutions.

The process of engineering design, while it involves engineering practices, is considered a separate set of disciplinary core ideas in the NRC *Framework* and in the NGSS. There are three basic ideas of engineering design: defining the problem, developing possible solutions, and improving the design.

Defining the problem "with precision" means having a clear understanding of specific criteria and constraints in a complex problem that might have a broader societal or environmental impact.

Developing possible solutions at middle school focuses not only on generating design ideas but also on a process of evaluating different ideas that have been proposed in a systematic way, such as a trade-off matrix to determine the most promising designs. Those most promising designs would be tested, and solution results would be combined in a new solution.

Optimizing the design involves an iterative process of testing the best design, systematically analyzing the results, modifying the design while controlling variables, retesting, comparing results, and again modifying the design. Students may go through this cycle several times to optimize a design. Students need to know that failure is not only OK, but expected, in engineering design. Having something fail drives you to improve the system and make progress.

Collaboration is an important aspect of engineering design; learning from the successes and failures of other design groups can be very productive. In Investigation 5, students extensively explore the disciplinary core ideas of engineering design in the context of energy transfer through an iterative process of design. However, students can engage in engineering practices without fully engaging in the iterative process, as they do in other investigations in this course. FOSS has a continuum of engagement in the engineering practices and process, from short experiences to more in-depth experiences where students reflect on core ideas about the design process.

CONCEPTUAL FRAMEWORK
Engineering Design: Weather and Water

Concept A Defining and delimiting engineering problems.

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge likely to limit possible solutions.

Concept B Developing possible solutions.

- A solution needs to be tested and then modified on the basis of the test results, in order to improve it.
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.
- Models of all kinds are important for testing solutions.

Concept C Optimizing the design solution.

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.
- 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.

Earth Science with Physical Science Content Sequence

This table shows modules and courses for grades K–8 in the FOSS content sequence that focus on energy transfer in Earth systems, with an emphasis on the modules that inform the complex systems strand. The supporting elements in these modules (somewhat abbreviated) are listed. The elements for the **Weather and Water Course** are expanded to show how they fit into the sequence.

	EARTH SCIENCE	
Module or course	**Structure of Earth**	**Earth Interactions**
Weather and Water (middle school)		
Earth and Sun (grade 5)	• Most of Earth's air resides in the troposphere, where weather happens. • Most of Earth's water is in the ocean; most of Earth's fresh water is in glaciers and underground. • Weather is described in terms of variables including temperature, humidity, precipitation, wind, and air pressure. • Scientists observe, measure, and record patterns of weather to make predictions. • The Sun is the major source of energy that heats Earth.	• The different energy-transferring properties of earth materials lead to uneven heating of Earth's surface and convection currents. • The water cycle is driven by the Sun and involves evaporation and condensation. • Energy transfers to earth materials by radiation, conduction, and convection. • Climate—the range of an area's typical weather conditions—is changing globally; this change will affect all life.
Water and Climate (grade 3)	• Water is found almost everywhere on Earth, (e.g., vapor, clouds, rain, snow, ice). Most of Earth's water is in the ocean. • Water expands when heated, contracts when cooled, and expands when frozen. • Cold water is more dense than warmer water; liquid water is more dense than ice. • Scientists observe, measure, and record patterns of weather to make predictions. • Soils retain more water than rock particles alone.	• Water moves downhill; the steeper the slope, the faster water moves. • Ice melts when heated; liquid water freezes when cooled. • Evaporation is the process by which liquid (water) changes into gas (water vapor). • Condensation is the process by which gas (water vapor) changes into liquid (water). • Climate is the range of an area's typical weather. • A variety of natural hazards result from weather-related phenomena.
Air and Weather (grade 1)	• Air is matter (gas) and takes up space. • Weather describes conditions in the air outdoors. • Weather conditions can be measured using tools such as thermometers, wind vanes, anemometers, and rain gauges. • Clouds are made of liquid water drops. • Natural sources of water include streams, rivers, lakes, and the ocean.	• The Sun heats Earth during the day. • Wind is moving air. • Daily changes in temperature, precipitation, and weather type can be observed, compared, and predicted. • Each season has typical weather conditions that can be observed, compared, and predicted. • Weather affects animals and plants.
Trees and Weather (grade K)	• Weather is the condition of the air outdoors; weather changes. • Temperature is how hot or cold it is, and can be measured with a thermometer. • Wind is moving air; wind socks indicate wind direction and speed.	• Each season has typical weather conditions that can be observed, compared, and predicted. • Trees change through the seasons.

Weather and Water	Structure of Earth	Earth Interactions
	•Weather is the condition of Earth's atmosphere at a given time in a given place; climate is the range of an area's weather conditions over years. •The atmosphere is a mixture of permanent and variable gases. Weather happens in the troposphere. •Density is a ratio of a mass and its volume. •The angle at which light from the Sun strikes the surface of Earth is the solar angle. This angle changes with latitude and, for any location, with the seasons.	•Complex patterns of interactions determine local weather patterns. •The faster a particle is moving, the more kinetic energy it has. • Temperature is a measure of the average kinetic energy of particles of matter. The amount of energy transfer needed to change the temperature of a sample of matter depends on the size of the sample and the environment. •Energy transfers from hotter regions or objects into colder regions. •Energy transfers from one place to another by radiation and conduction. • Convection is the circulation of a fluid that results from energy transfer in a fluid. • When air masses of different densities meet, weather changes. • The Sun's energy drives the water cycle and weather. • If Earth's mean temperature continues to rise, organisms, including humans, will be affected in many ways. Human activities are major factors in the current rise in Earth's mean surface temperature.

NOTE

See the Assessment chapter in this *Investigations Guide* for more details on how the FOSS embedded and benchmark assessment opportunities align with the conceptual frameworks and the learning progressions. In addition, the Assessment chapter describes specific connections between the FOSS assessments and the NGSS performance expectations.

The NGSS Performance Expectations addressed in this course include:

Physical Sciences
MS-PS1-4
MS-PS3-3
MS-PS3-4
MS-PS3-5

Earth and Space Sciences
MS-ESS1-1
MS-ESS2-4
MS-ESS2-5
MS-ESS2-6
MS-ESS3-2
MS-ESS3-3
MS-ESS3-4
MS-ESS3-5

Engineering, Technology, and the Applications of Science
MS-ETS1-1
MS-ETS1-2
MS-ETS1-3
MS-ETS1-4

See pages 38–44 in this chapter for more details on the grades 6–8 NGSS performance expectations.

CONNECTIONS TO NGSS BY INVESTIGATION

Inv. 1: What Is Weather?

Science and Engineering Practices

Asking questions
Developing and using models
Planning and carrying out investigations
Analyzing and interpreting data
Using mathematics and computational thinking
Constructing explanations
Engaging in argument from evidence
Obtaining, evaluating, and communicating information

Connections to Common Core State Standards—ELA

Reading—Literacy in Science and Technical Subjects

1. Cite evidence to support analysis of science and text.
2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text.
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases.
5. Analyze the structure an author uses to organize a text.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.
7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually.
10. Read and comprehend science independently and proficiently.

Writing—Literacy in Science and Technical Subjects

1. Write arguments.
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
5. Develop and strengthen writing.
8. Gather relevant information from multiple print and digital sources.
9. Draw evidence from informational texts to support analysis, reflection, and research.

Speaking and Listening

1. Engage effectively in a range of collaborative discussions with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly.
4. Present claims and findings.
5. Include multimedia components and visual display in presentations.

Language

4. Determine or clarify the meaning of unknown words and phrases.
5. Demonstrate understanding of word relationships and nuances in word meanings.
6. Acquire and use academic and domain-specific words and phrases.

Disciplinary Core Ideas		Crosscutting Concepts
PS1.A: Structure and properties of matter • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. **(MS-PS1-4)** • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. **(MS-PS1-4)**	**ESS2.C: The roles of water in Earth's surface processes** • The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. **(MS-ESS2-5)** **ESS2.D: Weather and climate** • Because these patterns are so complex, weather can only be predicted probabilistically. **(MS-ESS2-5)**	Patterns Cause and effect Systems and system models Stability and change

Inv. 2: Air Pressure and Wind

Science and Engineering Practices	Connections to Common Core State Standards—ELA
Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Obtaining, evaluating, and communicating information	**Reading—Literacy in Science and Technical Subjects** 1. Cite evidence to support analysis of science and text. 2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases. 5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic. 6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text 7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually. 9. Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text. 10. Read and comprehend science/technical texts complexity band independently and proficiently. **Writing—Literacy in Science and Technical Subjects** 5. Develop and strengthen writing. 8. Gather relevant information from multiple print and digital sources. 9. Draw evidence from informational texts to support analysis, reflection, and research. **Speaking and Listening** 1. Engage effectively in a range of collaborative discussions with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly. 3. Delineate and evaluate a speaker's argument. 4. Present claims and findings. 5. Include multimedia components and visual display in presentations. **Language** 5. Demonstrate understanding of word relationships and nuances in word meanings. 6. Acquire and use academic and domain-specific words and phrases.

Disciplinary Core Ideas		Crosscutting Concepts
PS1.A: Structure and properties of matter • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. **(MS-PS1-4)** • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. **(MS-PS1-4)**	**ESS2.C: The roles of water in Earth's surface processes** • The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. **(MS-ESS2-5)** **ESS2.D: Weather and climate** • Because these patterns are so complex, weather can only be predicted probabilistically. **(MS-ESS2-5)**	Patterns Cause and effect Scale, proportion, and quantity

Inv. 3: Convection

Science and Engineering Practices	Connections to Common Core State Standards—ELA
Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Obtaining, evaluating, and communicating information	**Reading—Literacy in Science and Technical Subjects** 1. Cite evidence to support analysis of science and text. 2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text. 7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually. 9. Compare and contrast information from experiments, simulations, video, or multimedia sources with that from reading a text. 10. Read and comprehend science texts independently and proficiently. **Writing—Literacy in Science and Technical Subjects** 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 5. Develop and strengthen writing. **Speaking and Listening** 1. Engage effectively in a range of collaborative discussions with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly. **Language** 4. Determine or clarify meaning of unknown words and phrases. 5. Demonstrate understanding of word relationships and nuances in word meanings.

Disciplinary Core Ideas		Crosscutting Concepts
PS1.A: Structure and properties of matter • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. **(MS-PS1-4)** • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. **(MS-PS1-4)** **PS3.B: Conservation of energy and energy transfer** • The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. **(MS-PS3-4)** • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **(MS-PS3-4)**	**ESS2.C: The roles of water in Earth's surface processes** • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. **(MS-ESS2-6)** **ESS2.D: Weather and climate** • Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. **(MS-ESS2-6)**	Patterns Cause and effect Scale, proportion, and quantity Systems and system models Energy and matter

Inv. 4: Radiation

Science and Engineering Practices	Connections to Common Core State Standards—ELA
Asking questions Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Obtaining, evaluating, and communicating information	**Reading—Literacy in Science and Technical Subjects** 10. Read and comprehend science independently and proficiently. **Writing—Literacy in Science and Technical Subjects** 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 5. Develop and strengthen writing. 8. Gather relevant information from multiple print and digital sources, using search terms effectively. **Speaking and Listening** 1. Engage effectively in a range of collaborative discussions with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly. 3. Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced. 5. Include multimedia components and visual display in presentations. 6. Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. **Language** 4. Determine or clarify meaning of unknown words and phrases. 5. Demonstrate understanding of word relationships and nuances in word meanings. 6. Acquire and use academic and domain-specific words and phrases.

Disciplinary Core Ideas		Crosscutting Concepts
PS3.A: Definitions of energy • Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. **(MS-PS3-4)** **PS3.B: Conservation of energy and energy transfer** • When the motion energy of an object changes, there is inevitably some other change in energy at the same time. **(MS-ESS3-5)** • The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. **(MS-ESS3-4)**	**ESS1.B: Earth and the solar system** • Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. **(MS-ESS1-1)** **ESS2.D: Weather and climate** • Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. **(MS-ESS2-6)**	Patterns Cause and effect Scale, proportion, and quantity Systems and system models Energy and matter Stability and change

Inv. 5: Conduction

Science and Engineering Practices	Connections to Common Core State Standards—ELA
Asking questions and defining problems Developing and using models Planning and carrying out investigations Analyzing and interpreting data Constructing explanations and designing solutions Obtaining, evaluating, and communicating information	**Reading—Literacy in Science and Technical Subjects** 1. Cite evidence to support analysis of science texts. 5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic. 6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text. 7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually. 9. Compare and contrast information from experiments, simulations, video, or multimedia sources with that from reading a text. 10. Read and comprehend science texts independently and proficiently. **Writing—Literacy in Science and Technical Subjects** 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. 4. Produce clear and coherent writing. 5. Develop and strengthen writing. 9. Draw evidence from informational texts to support analysis, reflection, and research. **Speaking and Listening** 1. Engage effectively in a range of collaborative discussions with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly. 2. Interpret and analyze information presented in diverse media. 4. Present claims and findings. **Language** 4. Determine or clarify the meaning of unknown words and phrases. 5. Demonstrate understanding of word relationships and nuances in word meanings.

Disciplinary Core Ideas		Crosscutting Concepts
PS3.A: Definitions of energy • Temperature is a measure of the average kinetic energy of particles of matter. **(MS-PS3-3)** **PS3.B: Conservation of energy and energy transfer** • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **(MS-PS3-3)**	**ETS1.A: Defining and delimiting engineering problem** • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge likely to limit possible solutions. **(MS-ETS1-1)** **ETS1.B: Developing possible solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. **(MS-ETS1-2; MS-ETS1-3; MS-ETS1-4)** • Models of all kinds are important for testing solutions. **(MS-ETS1-4)** **ETS1.C: Optimizing the design solution** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. 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. **(MS-ETS1-3; MS-ETS1-4)**	Cause and effect Systems and system models Energy and matter Structure and function

Inv. 6: Air Flow

Science and Engineering Practices	Connections to Common Core State Standards—ELA
Developing and using models Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Obtaining, evaluating, and communicating information	**Reading—Literacy in Science and Technical Subjects** 1. Cite evidence to support analysis of science and text. 2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases. 6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text. 7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually. 9. Compare and contrast information from experiments, simulations, video, or multimedia sources with that from reading a text. 10. Read and comprehend science independently and proficiently. **Writing—Literacy in Science and Technical Subjects** 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. 4. Produce clear and coherent writing. 5. Develop and strengthen writing. 8. Gather relevant information from multiple print and digital sources. 9. Draw evidence from informational texts to support analysis, reflection, and research. **Speaking and Listening** 1. Engage effectively in a range of collaborative discussions with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly. 4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound reasoning, and well-chosen details. **Language** 4. Determine or clarify meaning of unknown words and phrases. 5. Demonstrate understanding of word relationships and nuances in word meanings.

Disciplinary Core Ideas		Crosscutting Concepts
PS1.A: Structure and properties of matter • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. **(MS-PS1-4)** **PS3.A: Definitions of energy** • Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. **(MS-PS1-4)** **PS3.B: Conservation of energy and energy transfer** • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **(MS-PS1-4)**	**ESS2.C: The roles of water in Earth's surface processes** • The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. **(MS-ESS2-5)** • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. **(MS-ESS2-6)** **ESS2.D: Weather and climate** • Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. **(MS-ESS2-6)**	Patterns Cause and effect Systems and system models Energy and matter

Inv. 7: Water in the Air

Science and Engineering Practices	Connections to Common Core State Standards—ELA
Asking questions Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Engaging in argument from evidence Obtaining, evaluating, and communicating information	**Writing—Literacy in Science and Technical Subjects** 1. Write arguments. 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. 4. Produce clear and coherent writing. **Speaking and Listening** 1. Engage effectively in a range of collaborative discussions with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly. 3. Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced. 4. Present claims and findings. 6. Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. **Language** 4. Determine or clarify meaning of unknown words and phrases. 5. Demonstrate understanding of word relationships and nuances in word meanings. 6. Acquire and use academic and domain-specific words and phrases.

Disciplinary Core Ideas		Crosscutting Concepts
PS1.A: Structure and properties of matter • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. **(MS-PS1-4)** • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. **(MS-PS1-4)** • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. **(MS-PS1-4)** **PS3.A: Definitions of energy** • Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. **(MS-PS1-4)**	**PS3.B: Conservation of energy and energy transfer** • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **(MS-PS3-3)** **ESS2.C: The roles of water in Earth's surface processes** • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. **(MS-ESS2-4)** • Global movements of water and its changes in form are propelled by sunlight and gravity. **(MS-ESS2-4)**	Cause and effect Scale, proportion, and quantity Systems and system models Energy and matter

Science and Engineering Practices	Connections to Common Core State Standards—ELA
Developing and using models Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Obtaining, evaluating, and communicating information	**Reading—Literacy in Science and Technical Subjects** 1. Cite evidence to support analysis of science and text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases. 5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic. 6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text. 7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually. 9. Compare and contrast information from experiments, simulations, video, or multimedia sources with that from reading a text. 10. Read and comprehend science independently and proficiently. **Writing—Literacy in Science and Technical Subjects** 2. Write informative/explanatory texts, including scientific experiments, or technical processes. 4. Produce clear and coherent writing. 5. Develop and strengthen writing. 7. Conduct short research projects to answer a question. 8. Gather relevant information from multiple print and digital sources. 9. Draw evidence from informational texts to support analysis, reflection, and research. **Speaking and Listening** 1. Engage effectively in a range of collaborative discussions with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly. **Language** 4. Determine or clarify meaning of unknown words and phrases. 5. Demonstrate understanding of word relationships and nuances in word meanings.

Disciplinary Core Ideas		Crosscutting Concepts
ESS2.C: The roles of water in Earth's surface processes • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. **(MS-ESS2-4)** • The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. **(MS-ESS2-5)** • Global movements of water and its changes in form are propelled by sunlight and gravity. **(MS-ESS2-4)** • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. **(MS-ESS2-6)** **ESS2.D: Weather and climate** • Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. **(MS-ESS2-6)** • Because these patterns are so complex, weather can only be predicted probabilistically. **(MS-ESS2-5)** • The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. **(MS-ESS2-6)**	**ESS3.C: Human impacts on Earth systems** • Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **(MS-ESS3-4)**	Patterns Cause and effect Scale, proportion, and quantity Systems and system models Energy and matter

Inv. 9: Climate over Time

Science and Engineering Practices	Connections to Common Core State Standards—ELA
Asking questions Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Engaging in argument from evidence Obtaining, evaluating, and communicating information	**Reading—Literacy in Science and Technical Subjects** 2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases. 5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic. 7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually. 8. Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. 9. Compare and contrast information from experiments, simulations, video, or multimedia sources with that from reading a text. 10. Read and comprehend science independently and proficiently. **Writing—Literacy in Science and Technical Subjects** 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 4. Produce clear and coherent writing. 5. Develop and strengthen writing. 8. Gather relevant information from multiple print and digital sources. 9. Draw evidence from informational texts to support analysis, reflection, and research. **Speaking and Listening** 1. Engage effectively in a range of collaborative discussions with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly. 2. Interpret and analyze information presented in diverse media. **Language** 6. Acquire and use academic and domain-specific words and phrases.

Disciplinary Core Ideas

ESS2.D: Weather and climate

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. **(MS-ESS2-6)**
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. **(MS-ESS2-6)**

ESS3.B: Natural hazards

- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces, can help forecast the locations and likelihoods of future events. **(MS-ESS3-2)**

ESS3.C: Human impacts on Earth systems

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)**
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **(MS-ESS3-3; MS-ESS3-4)**

ESS3.D: Global climate change

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior, and on applying that knowledge wisely in decisions and activities. **(MS-ESS3-5)**

Crosscutting Concepts

Patterns
Cause and effect
Scale, proportion, and quantity
Systems and system models
Energy and matter
Stability and change

Inv. 10: Meteorology

Science and Engineering Practices	Connections to Common Core State Standards—ELA
Asking questions Developing and using models Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Engaging in argument from evidence Obtaining, evaluating, and communicating information	**Reading—Literacy in Science and Technical Subjects** 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases. 7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually. **Writing—Literacy in Science and Technical Subjects** 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. 4. Produce clear and coherent writing. **Speaking and Listening** 1. Engage effectively in a range of collaborative discussions with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly. **Language** 5. Demonstrate understanding of word relationships and nuances in word meanings.

Disciplinary Core Ideas		Crosscutting Concepts
ESS2.C: The roles of water in Earth's surface processes • The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. **(MS-ESS2-5)** **ESS2.D: Weather and climate** • Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. **(MS-ESS2-6)** • Because these patterns are so complex, weather can only be predicted probabilistically. **(MS-ESS2-5)**		Patterns Cause and effect Systems and system models Energy and matter Stability and change

RECOMMENDED FOSS NEXT GENERATION K–8 SCOPE AND SEQUENCE

Grade	Integrated Middle Grades				
6–8	Heredity and Adaptation*	Electromagnetic Force*	Gravity and Kinetic Energy*	Waves*	Planetary Science
	Chemical Interactions		Earth History		Populations and Ecosystems
	Weather and Water		Diversity of Life		Human Systems Interactions*

**Half-length courses* *Physical Science content* *Earth Science content* *Life Science content* *Engineering content*

Grade	Physical Science	Earth Science	Life Science
5	Mixtures and Solutions	Earth and Sun	Living Systems
4	Energy	Soils, Rocks, and Landforms	Environments
3	Motion and Matter	Water and Climate	Structures of Life
2	Solids and Liquids	Pebbles, Sand, and Silt	Insects and Plants
1	Sound and Light	Air and Weather	Plants and Animals
K	Materials and Motion	Trees and Weather	Animals Two by Two