Sixth Grade

South Carolina sixth-grade students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The **performance expectations** in sixth grade help students engage in inquiry questions such as, **but not limited to:**

What factors interact and influence weather and climate? Students use models and explore with evidence factors that control weather and climate.	**How do waves behave?** Students describe how mechanical and light waves behave when interacting with matter.
How do cells contribute to the function of living organisms and the organism's response to its environment? Students investigate that all organisms are made of cell(s), describe that special cells or structures are responsible for particular functions in organisms, and explain with evidence that for many organisms the body is a system of multiple interacting subsystems that form a hierarchy from cells to the body. Students synthesize information that sensory receptors respond to stimuli for behaviors or memory storage.	**How can a substance be changed by energy and how can energy be transferred from one object or system to another?** Students predict and investigate the relationship between energy (kinetic energy of moving objects) and temperature (average kinetic energy of particles in matter). Students also apply the engineering design process to develop a device that controls energy transfer.
How do the materials in and on Earth's crust change over time? Students describe how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. Students investigate the properties of important materials and construct explanations based on the analysis of real geoscience data.	**How do we know that the Earth and life on Earth have changed through time?** Students construct explanations based on geoscience data (locations and prevalence of specific rock types, fossils, continental features, ocean floor features, and earthquake events) to support that Earth and life on Earth has changed over time.
How do natural hazards and technologies impact Earth's systems and people? Students analyze and interpret natural hazards data for patterns to predict and reduce their impact on humans through use and development of new technologies.	

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Sixth Grade

Through the sixth-grade performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In sixth grade, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS1, PS3, PS4) • Life Science (LS1) • Earth and Space Science (ESS1, ESS2, ESS3) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Scale, Proportion, and Quantity • Systems and System Models • Energy and Matter • Structure and function

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Matter and Its Interactions (PS1) 6		
6-PS1-4. Develop and use 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.* ***State Assessment Boundary:*** *The use of mathematical formulas is not required.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 6-8 builds on K-5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena. NRC Framework Link	**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. In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. NRC Framework Link (continued on next page)	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. NRC Framework Link

	PS3.A: Definitions of Energy The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning, it refers to the energy transferred due to the temperature difference between two objects. (*secondary*) The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. (*secondary*) Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (*secondary*) NRC Framework Link	

6-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 polystyrene foam cup.*
State Assessment Boundary: *Assessment does not include calculating the total amount of thermal energy transferred.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. NRC Framework Link	**PS3.A: Definitions of Energy** The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and energy transfers by convection, conduction, and radiation (particularly infrared and light). NRC Framework Link **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. Energy is spontaneously transferred out of hotter regions or objects and into colder ones by the processes of conduction, convection, and radiation. NRC Framework Link (continued on next page)	**Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system. NRC Framework Link

	ETS1.A: Defining and Delimiting an Engineering Problem The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. NRC Framework Link **ETS1.B: Developing Possible Solutions** A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. NRC Framework Link	

Energy (PS3)		
6-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.* ***State Assessment Boundary:*** *Assessment does not include calculating the total amount of thermal energy transferred.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. NRC Framework Link	**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. NRC Framework Link **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. NRC Framework Link	**Scale, Proportion, and Quantity** Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. NRC Framework Link

Waves and Their Applications in Technologies for Information Transfer (PS4)

6

6-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Clarification Statement: *Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.*
State Assessment Boundary: *Assessment is limited to qualitative applications pertaining to light and mechanical waves.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**PS4.A: Wave Properties** A sound wave needs a medium through which it is transmitted. NRC Framework Link **PS4.B: Electromagnetic Radiation** When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves. NRC Framework Link	**Structure and Function** Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

6-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

Clarification Statement: *Emphasis is on developing evidence that living things are made of at least one cell, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.*
State Assessment Boundary: *Assessment does not include identification of specific cell types and should emphasize the use of evidence from investigations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. NRC Framework Link	**LS1.A: Structure and Function** All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). NRC Framework Link ETS2 **ETS2.A: 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. NRC Framework Link	**Scale, Proportion, and Quantity** Phenomena that can be observed at one scale may not be observable at another scale. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

6

6-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function.

Clarification Statement: *Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.*
State Assessment Boundary: *Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**LS1.A: Structure and Function** Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. NRC Framework Link	**Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

6

6-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

Clarification Statement: *Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.*
State Assessment Boundary: *Assessment does not include the mechanism of one body system independent of others or individual organs and structures. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, skeletal, and nervous systems and is limited to the interdependence of the body systems.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. NRC Framework Link	**LS1.A: Structure and Function** In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. NRC Framework Link	**Systems and System Models** Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

6

6-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Clarification Statement: *Examples of stimulus and sensory receptor pairings include electromagnetic stimuli (light intensity and color) are received by the eye; mechanical stimuli (sound waves) are received by the hair cells of the inner ear; mechanical stimuli (pressure) are received by the skin; and chemical stimuli (foods) are received by the various taste buds.*
State Assessment Boundary: *Assessment does not include identifying specific structures of the brain or mechanisms for the transmission of this information.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. NRC Framework Link	**LS1.D: Information Processing** Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. Changes in the structure and functioning of many millions of interconnected nerve cells allow combined inputs to be stored as memories for long periods of time. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural systems. NRC Framework Link

Earth's Place in the Universe (ESS1)

6

6-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

Clarification Statement: *Emphasis is on analyses of rock formations and the fossils they contain to establish relative ages of major events in Earth's history. Scientific explanations can include models to study the geologic time scale.*
State Assessment Boundary: *Assessment does not include recalling the names of specific periods or epochs and events within them.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**ESS1.C: The History of Planet Earth** The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. Major historical events include the formation of mountain chains and ocean basins, the adaptation and extinction of particular living organisms, volcanic eruptions, periods of massive glaciation, and development of watersheds and rivers through glaciation and water erosion. NRC Framework Link	**Scale, Proportion, and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. NRC Framework Link

Earth's Systems (ESS2)		
6-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. ***Clarification Statement:*** *Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.* ***State Assessment Boundary:*** *Assessment does not include the identification and naming of minerals.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**ESS2.A: Earth Materials and Systems** All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. NRC Framework Link	**Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion/and or cycling of matter. NRC Framework Link

Earth's Systems (ESS2)

6

6-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

Clarification Statement: *Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually, but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.*
State Assessment Boundary: *Assessment does not include identification or naming of specific events.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**ESS2.A: Earth Materials and Systems** The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. NRC Framework Link **ESS2.C: The Roles of Water in Earth's Surface Processes** Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. NRC Framework Link	**Scale Proportion and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. NRC Framework Link

Earth's Systems (ESS2)

6-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

Clarification Statement: *Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), the locations of ocean structures (such as ridges, fracture zones, and trenches), and the prevalence of earthquakes and volcanoes along plate boundaries.*
State Assessment Boundary: *Paleomagnetic anomalies in oceanic and continental crust are not assessed.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to provide evidence for phenomena. NRC Framework Link	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geological history. Plate movements are responsible for most continental and ocean floor features and for the distribution of most rocks and minerals within Earth's crust. Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. NRC Framework Link (continued on next page)	**Patterns** Patterns in rates of change and other numerical relationships can provide information about natural systems. NRC Framework Link

	ETS2.A: Interdependence of Science, Engineering, and Technology Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. NRC Framework Link	

Earth's Systems (ESS2)		
6-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.* ***State Assessment Boundary:*** *Assessment does not include a quantitative understanding of the latent heats of vaporization and fusion.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms. NRC Framework Link	**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. Global movements of water and its changes in form are propelled by sunlight and gravity. NRC Framework Link	**Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. NRC Framework Link

Earth's Systems (ESS2)

6-ESS2-5. Analyze and interpret 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).*
State Assessment Boundary: *Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to provide evidence for phenomena. NRC Framework Link	**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. NRC Framework Link **ESS2.D: Weather and Climate** Because these patterns are so complex, weather can only be predicted probabilistically. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. NRC Framework Link

Earth's Systems (ESS2)

6-ESS2-6. Develop and use models to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

Clarification Statement: *Emphasis is on patterns of global and regional climate that vary due to atmospheric circulation, oceanic circulation, and geographic land features.*
State Assessment Boundary: *Assessment does not include the dynamics of the Coriolis Effect, thermohaline circulation, or the role of density.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**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. NRC Framework Link **ESS2.D: Weather and Climate** The tilt of the earth's rotational axis causes a pattern of uneven heating and cooling that changes seasonally and establishes global patterns of climate and weather. Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. NRC Framework Link	**Systems and System Models** Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy, matter, and information flows within systems. NRC Framework Link

Earth and Human Activity (ESS3)

6

6-ESS3-2. Analyze and interpret data on natural hazards to identify patterns, which help forecast future catastrophic events and inform the development of technologies to mitigate their effects.

Clarification Statement: *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).*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. NRC Framework Link	**ESS3.B: Natural Hazards** 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. 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. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time. NRC Framework Link	**Patterns** Graphs, charts, and images can be used to identify patterns in data. NRC Framework Link