SOUTH CAROLINA
DEPARTMENT OF EDUCATION

Sixth Grade Performance Targets

for the
South Carolina College- and Career-Ready Science Standards 2021

For use 2025-2026

July 2025

Ellen E. Weaver

State Superintendent of Education

Contents

Purpose and Use

Science is a way of understanding the physical universe using observation and experimentation to explain natural phenomena. Science also refers to an organized body of knowledge that includes core ideas to the disciplines and common themes that bridge the disciplines. As science educators we must take a 3-dimensional approach in facilitating student learning. By addressing content, science and engineering practices and crosscutting concepts, students can have relevant and evidence-based instruction that can help solve current and future problems.

This document is intended as a guide for discerning and describing features of students and their work who have met the stated Performance Expectation (PE). This document is not intended to be read from cover to cover, but to be used, when needed, to support teacher professional learning and curriculum decisions. This is not intended for student use, and thus is not written in student-friendly language. This is not a curriculum or a means to limit instruction in the classroom. Although each PE states a dedicated Science and Engineering Practice (SEP) and Crosscutting Concept (CCC), students will need to use the whole range of SEPs and CCCs to achieve success by the end of instruction.

Three-dimensional science learning requires discipline specific communication skills. This means that effective science learning occurs when students are expected to speak, listen, read, and write in ways that are appropriate to science. With each Performance Target, there are question/sentence stems and terminology to support student discourse about phenomena to help teachers facilitate the acquisition of science discourse. Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding. The terms and stems in this section are intended to provide a baseline for teachers, neither list is exhaustive nor complete.

In addition to the doing (SEP), thinking (CCC), and learning of science knowledge (Disciplinary Core Ideas) outlined here, students will also require a working knowledge of grade-level appropriate tools and techniques of science. Students should know and recognize how scientists and engineers use these tools and techniques, not just identify them. Students should be able to use these tools to gather data, describe how these tools gather data, and/or interpret data sampled from them. These tools and techniques for Grade 6 include all those previously identified and add or emphasize:

- 10x magnifier
- anemometer
- barometer
- beaker
- compass
- concave lens
- convex lens
- density cubes
- digital balance
- graduated syringe
- graduated cylinder
- heat lamp
- hot plate
- microscope
- plane mirror
- prism
- rain gauge
- scale
- sling psychrometer
- steam table
- thermometer
- timing device
- tongs
- triple beam balance

Document Updates

July 2025

- All Performance Expectation statements have been reformatted to call out each of the dimensions as follows:
  - Science and Engineering Practice – **bold**
  - Crosscutting Concept – *italicize*
  - Disciplinary Core Idea - regular
- Additional clarification for 6-PS1-4:
  - *There is no standard convention for representing particle motion in particle diagrams. Ensure students experience a wide range of representations of particle motion, for example lines, arrows, distance between particles, etc.
- Additional clarification for 6-ESS2-6:
  - *Traditionally, warm water currents are represented with red arrows and cool water currents are represented with blue arrows. However, other representations are also used, for example representing warm water currents with dashed arrows and cool water currents with solid arrows, etc. Ensure students pay close attention to symbol keys when interacting with maps.
- 6-PS4-2
  - path of light refracts at the interface between media (for example: from air through glass) when the speed of a light wave changes as it passes through different media,
- Additional Terminology
  - 6-PS4-2
    - behavior
    - property
    - opaque
    - seismic wave
    - translucent
  - 6-LS1-1
    - abiotic
    - biotic
  - 6-LS1-8
    - innate
    - learned
  - 6-ESS2-5
    - barometric pressure
    - millibar (mb)

June 2025

- Updated watermark to 2024-2025.
- Adjusted formatting and grammar.

PS1 – Matter and Its Interactions

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 formular 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.	**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. **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*)	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems.

*There is no standard convention for representing particle motion in particle diagrams. Ensure students experience a wide range of representations of particle motion, for example lines, arrows, distance between particles, etc.

Observable features of student performance by the end of the course:

1. **Components of the model**
    a. Students develop/use a model (conceptual, graphical, physical, etc.) and identify the relevant components, including:
        i. particles, including their motion,
        ii. the system within which the particles are contained,
        iii. the average kinetic energy of particles in the system,
        iv. thermal energy and temperature of the system,
        v. temperature of the system, and
        vi. a pure substance in one of the states of matter.
2. **Relationships**
    a. Students develop/use a model to describe the relationships between components, including:
        i. the motion of molecules in a system and the kinetic energy of the particles in a system
        ii. the average kinetic energy of particles and the temperature of the system, and
        iii. the transfer of thermal energy from one system to another, limited to:
            1. a change in kinetic energy of particles in that new system and
            2. the state of matter of the pure substance and particles motion (freely moving and not in contact with other particles; freely moving and loose contact with other particles; and vibrating and fixed position relative to other particles).
3. **Connections**
    a. Students develop/use a model to describe the relationship between:
        i. the addition or removal of thermal energy from a substance and the change in average kinetic energy of the particles in that substance,
        ii. the temperature of the system,
        iii. motions of particles in the gaseous phase, and
        iv. the collisions of those particles with other materials; these collisions create pressure.

b. Students develop/use a model to describe what happens when thermal energy is transferred into a substance/system, including:
    i. an increase in kinetic energy of the particles can cause:
        1. an increase in the temperature of the system as the motion of particles relative to each other increases and
        2. a substance to change from a solid to a liquid or from a liquid to a gas;
    ii. motion of particles in a gas increase, causing the moving particles in the gas to have greater kinetic energy, thereby colliding with particles in surrounding materials with greater force (limited to: the gas pressure of the system increases).
c. Students develop/use a model to describe what happens when thermal energy is transferred from a substance/system, including:
    i. decreased kinetic energy of the particles can cause:
        1. a decrease in the temperature of the system as the motion of the particles relative to each other decreases and
        2. a substance to change state from a gas to a liquid or from a liquid to a solid;
    ii. pressure that a gas exerts decreases because the kinetic energy of the gas molecules decreases, and the slower molecules exert less force in collisions with other molecules in surrounding materials.
d. Students develop/use a model to describe what happens when thermal energy is transferred from a substance/system, including how:
    i. decreased kinetic energy of the particles can cause:
        1. the motion of the particles relative to each other decreases, a decrease in temperature may be observed and
        2. a substance to change from a gas to a liquid or from a liquid to a solid;
    ii. when the kinetic energy of the gas particles decreases, the slower particles exert less force in collisions with other particles and surrounding materials, a decrease in gas pressure may be observed.
e. Students develop/use a model to describe the relationship between changes and pressure of a system and changes of the states of materials in the system.
    i. With a decrease in pressure, the addition of less thermal energy is required for a liquid to change to a gas. Less force is exerted on the surface of the liquid, which allows the liquid's particles to break away and enter the gaseous state.
    ii. With an increase in pressure, the addition of more thermal energy is required for a liquid to change to a gas. More force is exerted on the surface of the liquid, which limits the ability of a liquid's particles to break way and enter the gaseous state.

6-PS1-4 Academic Language

Question/Sentence Stems

- By looking at patterns in the data, I determined that ____ caused______.
- _______caused the patterns I am observing. I know this because ______.
- If _____happens, I predict that _____will occur.
- Even though I cannot see _________, it explains why _____ is happening.
- When I change ______ in the system, ______ is affected.
- In this situation, even a small change of _________can cause a big effect of ___.
- The probability that ________ caused ______ is _____. I know this because_______.
- The evidence _______ presented in the scenario supports the claim that causes ______.
- To conclude that ____ caused _____, the following evidence is needed _______.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- atom
- boil
- condense
- evaporate
- freeze
- gas
- inert
- kinetic energy
- liquid
- matter
- melt
- molecule
- particle
- particle motion
- phase
- phase change
- pressure
- pure substance
- solid
- system
- temperature
- thermal energy
- vapor
- vibration

PS3 – Energy

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.	**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). **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. **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. **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.	**Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system.

Observable features of student performance by the end of the course:

1. **Using scientific knowledge to generate design solutions**
    a. Students demonstrate an understanding of the electromagnetic spectrum and the behavior of electromagnetic waves, including:
        i. when visible light hits dark surfaces, it transforms into infrared light,
        ii. all electromagnetic energy is collectively called light,
        iii. energy transfer by convection, conduction, and radiation, and
        iv. behaviors of waves (absorption, reflection, transmission [concepts more fully addressed in 6-PS4-2]).
    b. Students design and build a solution to a problem that requires either maximizing or minimizing thermal energy transfer. In the designs, students:
        i. identify that thermal energy is transferred from hotter objects to colder objects (emphasis on conduction, convection, and radiation),
        ii. describe different types of materials used in the design solution and their physical properties (for example: heat conductivity, reflectivity, thickness, etc.) and how these materials will be used to maximize or minimize thermal energy transfer, and/or
        iii. specify how the device will solve the problem.
2. **Describing criteria and constraints, including quantification when appropriate**
    a. Students describe the constraints and criteria that will be considered in the design solution.
        i. Students describe criteria, including:
            1. the maximum or minimum temperature difference that the device is required to maintain,
            2. the amount of time that the device is required to maintain the difference, and/or
            3. whether the device is intended to maximize or minimize the transfer of thermal energy.
        ii. Students describe constraints, which could include:
            1. cost,
            2. materials,
            3. safety, and
            4. time.
3. **Evaluating potential solutions**
    a. Students test the device to determine its ability to maximize or minimize the flow of thermal energy, using the rate of temperature change as a measure of success.
    b. Students use their knowledge of thermal energy transfer and the results of the testing to evaluate the design systematically against the constraints and criteria.

6-PS3-3 Academic Language

Question/Sentence Stems

- The ___structures help _____ to function because _______.
- I think that the ______ structures in the system [system name] function_______.
- ______are the structures in the optimal solution. is the function of the optimal solution. _____ is important about the relationship between structure and function in the optimal solution that makes it a successful design.
- When you put energy into this system ____.
- The flow of energy causes ________ to occur in the system.
- Energy is entering the system by __.
- The energy is leaving the system by ______.
- ______are some similarities and differences among the solutions.
- I can optimize my solution by _____.
- In the system, the cycling of matter ______.

Terminology to Support Student discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- absorption
- conduction
- conductor/conductivity
- constraint
- convection
- criterion/criteria
- data
- design solution
- energy transfer
- fluid
- heat
- heat transfer
- infrared light
- insulate/insulator
- kinetic energy
- maximize
- minimize
- modification
- optimize
- problem
- prototype
- radiation
- reflect/reflectivity
- retain/retention
- solar energy
- temperature
- test
- thermal energy
- thermometer
- visible light

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.	**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. **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.	**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.

Observable features of student performance by the end of the course:

1. **Identifying the phenomenon under investigation**
   a. Students identify the phenomenon under investigation involving thermal energy transfer.
   b. Students described the purpose of the investigation, including determining the relationships among the following factors:
      i. the transfer of thermal energy,
      ii. the type of matter,
      iii. the mass of the matter involved in thermal energy transfer, and
      iv. the change in the average kinetic energy of the particles (limited to change in temperature).
2. **Identifying the evidence to address the purpose of the investigation**
   a. Students describe the data to be collected and the evidence to be derived, including:
      i. initial and final temperatures of the materials used in the investigation,
      ii. types of matter used in the investigation, and
      iii. mass of matter used in the investigation.
3. **Planning the investigation**
   a. In the investigation plans, students describe:
      i. how the mass of materials is to be measured—including units,
      ii. how and when the temperatures of the materials are to be measured— including units, and/or
      iii. details of the experimental conditions that will allow appropriate data to be collected to address the purpose of the investigation (for example: time between temperature measurements, amounts of samples used, types of materials used, etc.), including appropriate independent and dependent variables and controls.

6-PS3-4 Academic Language

Question/Sentence Stems

- Based on the data I have; I predict the effect of a change in ______ on ________.
- __________ would make a good measure of [property, characteristic, or process] to investigate the phenomenon presented in the scenario.
- I compare how much of [property or characteristic] these two different _____ presented in the scenario.
- __________ scale should be used to investigate the mechanisms at work in this system. This is the best scale for the system because __.
- How could we test whether ___________ is changing, even though it looks like it is not?

Terminology to Support Student discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- conduction
- controlled variable
- dependent variable
- energy
- energy transfer
- heat
- independent variable
- proportional
- rate
- ratio
- temperature
- initial
- kinetic energy
- mass
- matter
- newton (N)
- particle
- particle motion
- thermal energy
- time
- variable
- volume

PS4 – Waves and Their Applications in Technologies for Information Transfer

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.	**P PS4.A: Wave Properties** A sound wave needs a medium through which it is transmitted. **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 [sic], like sound or water waves.	**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.

*The term "mechanical wave" is the appropriate description of sound and water waves.

Observable features of student performance by the end of the course:

1. **Components of the model**
    a. Students develop/use a model (conceptual, graphical, physical, etc.) and identify the relevant components, including:
        i. type of wave, i.e.:
            1. mechanical waves (for example: sound or water waves), including amplitudes, frequencies, and wavelength, and/or
            2. light, including brightness (amplitude) and color (frequency).
        ii. type of medium (limited to gas, liquid, solid) through which the waves are absorbed, reflected, or transmitted (including refraction),
        iii. relevant properties of the wave after interaction with the medium (for example: frequency, amplitude, wavelength), and/or
        iv. position of the wave's source.
2. **Relationships**
    a. Students develop/use a model to describe the relationships between components, including:
        i. How waves interact with media by being absorbed, reflected, and/or transmitted (including refraction),
        ii. path of light refracts at the interface between media (for example: from air through glass) when the speed of a light wave changes as it passes through different media,
        iii. mechanical waves require a medium to propagate, and
        iv. light does not require a medium for propagation (for example: space).
3. **Connections**
    a. Students develop/use a model to describe reflection, absorption, or transmission (including refraction) for light and mechanical waves as each interacts with different media.
    b. Students develop/use a model to describe why media with certain physical properties are well suited for some purposes (for example: lenses and mirrors, sound absorbers in concert halls, colored light filters, sound barriers next to highways, etc.).

6-PS4-2 Academic Language

Question/Sentence Stems

- The __________structures are present in ______ and are related to the function ______. These are shown in the model by ________.
- This system performs [describe functions]. I think the structures support or enable those functions by ____. The model shows _______ by ________.
- The model shows _________ behaviors are results of ______ structures which function
_____________ by ________.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- absorption
- amplitude
- barrier
- behavior
- bend
- brightness
- color
- color filter
- echo
- electromagnetic wave
- frequency
- lens
- light wave
- matter
- mechanical wave
- medium/media
- mirror
- opaque
- path
- prism
- propagate
- property
- proportion
- ray
- ray diagram
- reflection
- refraction/refracted
- seismic wave
- sound wave
- translucent
- transmit
- transparent
- visible light spectrum
- wave
- wavelength

LS1 – From Molecules to Organisms: Structures and Processes

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.	**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). **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.	**Scale, Proportion, and Quantity** Phenomena that can be observed at one scale may not be observable at another scale.

Observable features of student performance by the end of the course:

1. **Identifying the phenomenon under investigation**
    a. Students identify and describe evidence supporting that living things are made up of cells.
    b. Students identify and describe the purpose of an investigation, which includes providing evidence for the following ideas:
        i. All living things are made up of cells.
            1. One-celled organisms are called “unicellular.”
            2. Organisms made up of more than one cell are called “multicellular.”
        ii. The cell is the basic unit of life.

2. **Identifying the evidence to address the purpose of the investigation**
    a. Students describe the data to be collected and the evidence to be derived, including:
        i. the presence or absence of cells in living and nonliving things,
        ii. the presence or absence of any part of a living thing that is not made up of cells,
        iii. the presence or absence of cells in a variety of unicellular and multicellular organisms, and
        iv. different types of cells within one multicellular organism.
3. **Planning the investigation**
    a. Students describe how the tools and methods included in the experimental design will provide the necessary evidence to address the purpose of the investigation.
        i. Due to the small scale, most cells are not visible to the unaided eye and require devices engineered to magnify objects (for example: hand lens, microscope, etc.).
    b. Students describe how the tools used in the investigation are an example of how science depends on engineering advances.
4. **Collecting the data**
    a. Students collect and record data on the cellular composition of living organisms.
    b. Students identify the tools used to observe cells at different magnifications.
    c. Students evaluate collected data to determine whether the resulting evidence meets the goals of the investigation, including cellular composition as a distinguishing feature of living things.

6-LS1-1Academic Language

Question/Sentence Stems

- The scale of the model of ________ is ________ compared to the actual objects.
- To understand the phenomenon of _______, I/we can use a scale of ______ in my/our model.
- I/We need to use a scaled model because ______.
- The quantity of _________ and _______ can be compared.
- The proportion of _________ that is _______ is ________.
- The scale of the model of ________ is ________ compared to the actual objects.
- To understand the phenomenon of _____, I/we can use a scale of ____ in my/our model.
- To compare how much of [property or characteristic] these two different _____ presented in the scenario have we _______. We found that _______.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- abiotic
- algae
- animal
- bacteria
- biotic
- cell
- cell membrane
- cell wall
- chloroplast
- growth
- hand lens
- magnification
- microscope
- multicellular
- nucleus
- organism
- plant
- protist
- reproduce
- structure
- unicellular
- waste

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.	**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.	**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.

Observable features of student performance by the end of the course:

1. **Components of the model**
    a. Students develop/use a model (conceptual, graphical, physical, etc.) and identify the relevant components, including:
        i. cell membrane,
        ii. cell wall,
        iii. chloroplasts,
        iv. mitochondria, and
        v. nucleus.

2. **Relationships**
    a. Students develop/use a model describe the relationships between components, including:
        i. The functions of parts of cells in terms of their contributions to overall cellular functions (for example: chloroplast's role in photosynthesis and energy production; mitochondria's role in cellular respiration; nucleus's role in maintaining cell function; etc.).
        ii. The structure of the cell membrane or cell wall and its relationship to the function of the organelles and the whole cell (for example: the cell membrane's role in osmosis and diffusion, the cell wall's role in structural support).
3. **Connections**
    a. Students develop/use a model to describe how different parts of a cell contribute to cell functions, both separately and together with other structures, including:
        i. maintaining a cell's internal processes, for which it needs energy,
        ii. maintaining the cell's structure,
        iii. controlling what enters and leaves the cell, and
        iv. determines cellular function by performing as a system.
    b. Students develop/use a model to identify key differences between plant and animal cells based on structure and function including:
        i. Plant cells have a cell wall, providing structure to the plant, in addition to a cell membrane, whereas animal cells have only a cell membrane.
        ii. Plant cells contain organelles called chloroplasts, while animal cells do not. Chloroplasts conduct photosynthesis, producing sugars for the plant to use.

6-LS1-2 Academic Language

Question/Sentence Stems

- The __________ structures help ______ to function because ______.
- I/we think that the _________ structures in the system (choose the system) function ______.
- The __________ structures are present in ______ and are related to the function ______.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- active transport
- animal cell
- carbon dioxide
- cell
- cell membrane
- cell wall
- cellular respiration
- chloroplast
- diffusion
- energy
- eukaryote
- function
- homeostasis
- mitochondrion
- nucleus
- organelle
- osmosis
- oxygen
- photosynthesis
- plant cell
- structure
- sugar
- system

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.	**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.	**Systems and System Models** Systems may interact with other systems; they may have sub- systems and be a part of larger complex systems.

Observable features of student performance by the end of the course:

1. **Supported claims**
    a. Students make, support, or refute a claim that the body is or is not a system of interacting subsystems composed of groups of cells.
2. **Identifying scientific evidence**
    a. Students identify and describe the evidence (for example: data and scientific literature) used to support or refute a claim, including:
        i. Specialized groups of cells work together to form tissues (for example: evidence from data about the kinds of cells found in different tissues, such as nervous, muscular, and epithelial, and their functions, etc.).
        ii. Specialized tissues compromise each organ, enabling the specific organ functions to be carried out (for example: the heart contains muscle, connective, and epithelial tissues that allow the heart to receive and pump blood, etc.).

iii. Different tissues operate as organs (subsystems) to form organ systems that carry out complex functions (for example: the heart and blood vessels work together as the circulatory system to transport blood and materials throughout the body, etc.).
iv. The body contains organs and organ systems that interact with each other to carry out all necessary functions for survival and growth of the organism (for example: the digestive, respiratory, and circulatory systems are involved in the breakdown, uptake, and transport of nutrients and oxygen molecules throughout the body to the cells to be used for energy, growth, and repair, etc.).

3. **Evaluating and critiquing the evidence**
   a. Students evaluate and identify the strengths and weaknesses of the evidence, including:
      i. types of sources,
      ii. sufficiency, including validity and reliability, of the evidence to make and defend the claim, and
      iii. any alternative interpretations of the evidence and why the evidence supports or does not support the students claim, as opposed to any other claims.
4. **Reasoning and synthesis**
   a. Students use the following chain of reasoning to connect the appropriate evidence:
      i. Systems of interacting components function at every scale (for example: cells, tissues, organs, organ systems).
      ii. Organs are composed of interacting tissues. Each tissue is made up of specialized cells. These interactions at the cellular and tissue levels enabled the organs to carry out specific functions.
      iii. A body is a system of organs (subsystems) and organ systems that interact to carry out the functions necessary for life.

6-LS1-3 Academic Language

Question/Sentence Stems

- The key components of the system are________.
- In the system, _______________ and ______________ are shown in the model.
- In the system, _____________ and __________ work together to_________.
- In the system, _______________ and ________________ interact in __________________ way.
- If you change ______________ in the system, ___________ will occur.
- In the system, _______ is not shown in the model. This is not shown because___.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- anatomy
- body system
- cell
- circulatory system
- digestive system
- function
- hierarchal organization
- muscular system
- nervous system
- organ
- organ system
- respiratory system
- skeletal system
- structure
- subsystem
- tissue

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.	**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.	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural systems.

Observable features of student performance by the end of the course:

1. **Obtaining information**
    a. Students gather and synthesize information from at least two sources (for example: data, media, text, visual displays, etc.) that supports or does not support the relationship between sensory receptors and the storage and usage of sensory information organisms. Students gather information about:
        i. different types of sensory receptors and the types of inputs to which they respond (for example: electromagnetic, mechanical, chemical stimuli),
        ii. sensory information transmission along nerve cells from receptors to the brain, and
        iii. sensory information processing by the brain and spinal cord as:
            1. reflexes,
            2. behavioral response, and
            3. memories (limited to: stored information).
    b. Students gather sufficient information to provide evidence that illustrates the relationships between information received by sensory receptors and behavior, both immediate and over long timescales (for example: a loud noise processed via auditory receptors may cause an animal to startle or is encoded as a memory, which enables the animal to react appropriately in similar situations, etc.).
2. **Evaluating information**
    a. Students evaluate the information based on:
        i. the credibility, accuracy, and bias of each publication and the methods used to generate and collect the evidence;
        ii. the ability of the information to provide evidence that supports or refutes explanations that sensory receptors send signals to the brain, resulting in immediate behavioral changes or stored memories; and
        iii. the cause-and-effect relationships between the sensory receptors and behavioral responses to different stimuli and whether the information is sufficient to predict the response.

6-LS1-8 Academic Language

Question/Sentence Stems

- By looking at patterns in the data, I determined that ____ caused _____.
- _______caused the patterns I am observing. I know this because_____.
- If _____ happens, I predict that ____ will occur.
- Even though I cannot see __, it explains why _____ is happening.
- When I change _____ in the system, ______ is affected.
- In this situation, even a small change of __can cause a big effect of ________.
- The probability that ________ caused _____ is ____. I know this because_____.
- The evidence _______ presented in the scenario supports the claim that _____ causes ______.
- In order to conclude that _________ caused _____, the following evidence is needed.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- auditory receptors
- behavior
- brain
- chemical stimulus
- ear
- electromagnetic stimulus
- environment
- eye
- fall
- hear
- heat
- innate
- learned
- light
- mechanical stimulus
- memory
- nerve cells
- nose
- odor
- reflexes
- sense
- sensory input
- sensory receptor
- sight/vision
- skin
- sound
- spinal cord
- stimulus/stimuli
- system
- taste
- temperature
- tongue
- touch
- visible

ESS1 – Earth's Place in the Universe

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.	**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.	**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.

Observable features of student performance by the end of the course:

1. **Articulating the explanation of phenomena**
    a. Students articulate a statement describing/explaining how events in Earth's 4.6-billion- year history are organized relative to one another using the geologic time scale.

b. Students use evidence to describe how the relative order of events is determined on the geologic time scale using:
    i. rock strata and relative ages of rock units (for example: patterns of layering), and
    ii. major events in Earth's history and/or specific changes in fossils overtime (for example: formation of mountain ranges, formation of ocean basins, volcanic eruptions, glaciations, asteroid impacts, extinctions of groups of organisms, etc.).

2. **Evidence**
    a. Students identify and describe the evidence necessary for constructing the explanation, including:
        i. types and order of rock strata,
        ii. the fossil record, and
        iii. identification and evidence for major events in Earth's history (for example: volcanic eruptions, asteroid impacts, etc.).
    b. Students use multiple valid and reliable sources of evidence, including student experiments.
3. **Reasoning**
    a. Students use the following chain of reasoning to connect the evidence and support or refute an explanation for how the geologic time scale is used to construct a timeline of Earth's history:
        i. Unless disturbed by subsequent activity, younger rock layers lie above older rock layers, allowing for the relative ordering in time (limited to: older sedimentary rocks lie beneath younger sedimentary rocks) [principle of superposition].
        ii. Any rocks or features that cut across existing rock strata are younger than the rock strata that they cut across (for example: a fault cutting across older, existing rock strata is younger than rock stratum it cuts across) [principle of cross-cutting relations].
        iii. The fossil record can provide relative dates based on the appearance or disappearance of organisms (for example: fossil layers that contain only extinct animal groups are usually older than fossil layers that contain animal groups that are still alive today; layers with only microbial fossils are typically the earliest evidence of life).
        iv. Major events (for example: extensive lava flows, volcanic eruptions, asteroid impacts, etc.) can be used to indicate periods of time that occurred before a given event from periods that occurred after it.
        v. Using a combination of rock strata sequence, the fossil record, and evidence of major geologic events, the relative time ordering of events can be constructed as a model for Earth's history, even though the timescales involved are immensely vaster than the entire history of humanity.

6-ESS1-4 Academic Language

Question/Sentence Stems

- The scale of the model of __________ is _________ compared to the actual objects.
- To understand the phenomenon of ________, I/we can use a scale of _______ in my/our model.
- I/We need to use a scaled model because _______.
- The quantity of ___________ and _________ can be compared.
- The proportion of ___________ that is ________ is _________.
- The scale of the model of __________ is _________ compared to the actual objects.
- To understand the phenomenon of _____, I/we can use a scale of ____ in my/our model.
- To compare how much of [property or characteristic] these two different ________ presented in the scenario have we __________. We found that __________.

Terminology to Support Student Discourse about Phenomena

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- ancient
- asteroid/meteorite impact
- cross-cutting relationships
- extinction
- fault
- fold
- formation
- fossil
- fossil record
- geologic time scale
- geology
- igneous rock
- impact crater
- intrusion
- lava flow
- layer
- metamorphic rock
- mineral
- mountain range
- ocean basin
- prehistoric
- relative dating
- relative dating
- rock strata
- sediment
- sedimentary rock
- stratigraphy
- superposition
- unconformity
- uniformitarianism
- uplift

ESS2 – Earth's Systems

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.	**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.	**Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion/and or cycling of matter.

Observable features of student performance by the end of the course:

1. **Components of the model**
    a. Students develop/use a model (for example: rock cycle) and identify the relevant components, including:
        i. general types of Earth's materials can be found in different locations, including:
            1. those located at the surface (exterior) and or the interior, and
            2. those that existed before and/or after chemical and/or physical changes that occur during Earth processes (for example: melting, sedimentation, weathering, etc.).
        ii. solar energy,
        iii. energy from Earth's hot interior, and
        iv. relevant Earth processes.

2. **Relationships**
    a. Students develop/use a model to describe the relevant relationships between components, including:
        i. different Earth processes (for example: melting, crystallization, sedimentation) drive matter cycling through observable chemical and physical changes;
        ii. the movement of energy that originates from the Earth's hot interior causes the cycling of matter through the Earth's processes of melting, crystallization, and deformation;
        iii. solar energy causes the cycling of matter via processes that produce weathering, erosion, and deposition; and
        iv. relevant Earth processes last from seconds to billions of years and range from local to global scales.
3. **Connections**
    a. Students develop/use a model to describe (based on evidence for changes overtime and processes at different scales) that both the energy from the Earth's interior and the Sun drive Earth processes that cycle matter through the different forms of Earth's materials.
    b. Students develop/use a model to account for interactions between different Earth processes, including:
        i. The Earth's internal heat energy drives processes such as melting, crystallization, and deformation that can change the atomic arrangement of the elements in rocks. These processes also push rock material to the surface where it is subjected to weathering and erosion.
        ii. Solar energy drives the movement of wind and water that causes the erosion of weathered Earth materials.
        iii. Any rock on Earth can be changed into a new type of rock by processes driven by both Earth's internal energy and solar energy. This is called the rock cycle.

6-ESS2-1 Academic Language

Question/Sentence Stems

- ___ happens to matter as it moves within the system.
- The energy is leaving the system by _________.
- In this system, energy is entering by ________, doing ________ in the system, and leaving the system by __.
- The energy for __________ is from ________.
- When you put energy into this system ________.
- The flow of energy causes _________ to occur in the system.
- The energy is entering the system by ________.
- In the system, the cycling of matter ________.
- The matter in the system enters from ________.
- When the matter leaves the system, it goes _______.
- The flow of energy causes _________ to occur in the system as seen with _____ as evidence from the investigation.
- _ happens to _ when you put it together with ________________________ because the energy is ___.
- The flow of energy between _________ and ________ drives the changes to the system as seen by _________ because _______.
- My/Our diagram shows the flow energy in ________ as seen by _______ because.
- __ shows that _______________ is the evidence that energy is being conserved in this system because ________?

Terminology to Support Student Discourse about Phenomena

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- basalt
- cementation
- compaction
- conduction
- convection
- crystallization
- deformation
- deposition
- erosion
- granite
- igneous rock
- limestone
- mantle
- marble
- melting
- metamorphic rock
- metamorphism
- mineral
- pathway
- quartzite
- sandstone
- radiation
- rock
- rock cycle
- sediment
- sedimentary rock
- sedimentation
- shale
- slate
- solar energy
- thermal energy
- weathering
- uplift

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 [sic] 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.	**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. **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.	**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.

*The term "mountain range" is used in place of "mountain chain." Meteorite or asteroid impact is the appropriate term for when an object from space hits the surface of another object.

Observable features of student performance by the end of the course:

1. **Articulating the explanation of phenomena**
    a. Students articulate a statement that describes/explains how geoscience processes have changed the Earth's surface at varying time and spatial scales.
2. **Evidence**
    a. Students identify and describe the evidence necessary for constructing explanations, including:
        i. the slow and large-scale motion of the Earth's plates and the results of that motion,
        ii. surface weathering, erosion, and the deposition of sediment ranging from large to microscopic scales (for example: sediment consisting of boulders and microscopic grains of sand, raindrops dissolving minerals, etc.), and
        iii. rapid catastrophic events (for example: earthquakes, volcanoes, asteroid/meteorite impacts, etc.).
    b. Students identify the corresponding time scales for each identified geoscience process.
    c. Students use multiple valid and reliable sources to represent changes that occur on very large or very small spatial and/or temporal scales (for example: stream tables to illustrate erosion and deposition; maps and models to show the motion of tectonic plates, etc.).
3. **Reasoning**
    a. Students use the following chain of reasoning to connect the evidence and support or refute an explanation for how geoscience processes have changed the Earth's surface at a variety of temporal and spatial scales:
        i. The motion of earth's plates produces changes on a planetary scale over a range of time periods from millions to billions of years. Evidence for the motion of plates can explain large scale features of Earth's surface (for example: mountains, distribution of continents, etc.) and how they change.
        ii. Surface processes such as erosion, movement, weathering, and the deposition of sediment can modify surface features, such as mountains, or create new features, such as canyons. These processes can occur at spatial scales ranging from large to microscopic, and temporal/time scales ranging from seconds to hundreds of millions of years.
        iii. Catastrophic changes can modify or create surface features over a very short period compared to other geoscience processes. The results of those catastrophic changes are subject to further changes over time by processes acting on longer timescales (for example: erosion of an impact crater).

iv. A given surface feature is the result of a broad range of geoscience processes occurring at different temporal and spatial scales.
v. Surface features will continue to change in the future as geoscience processes continue to occur.

6-ESS2-2 Academic Language

Question/Sentence Stems

- The scale of the model of ________ is ________ compared to the actual objects.
- To understand the phenomenon of _______, I/we can use a scale of ______ in my/our model.
- I/We need to use a scaled model because ______.
- The quantity of _________ and _______ can be compared.
- The proportion of _________ that is _______ is ________.
- The scale of the model of ________ is ________ compared to the actual objects.
- To understand the phenomenon of ____, I/we can use a scale of __ in my/our model.
- To compare how much of [property or characteristic] these two different _____ presented in the scenario have we ______. We found that _______.

Terminology to Support Student Discourse about Phenomena

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- asteroid/meteorite impact
- cave
- compression
- continent
- continental drift
- converge
- convergent plate boundary
- deposition
- diverge
- divergent plate boundary
- earthquake
- erosion
- folding
- geosphere
- hotspot
- ice
- impact crater
- landslide
- lava
- mountain range
- ocean
- plate boundary
- plate tectonics
- pressure
- shearing
- subduction
- tension
- transform plate boundary
- uplift
- volcanic activity
- volcano
- weathering
- wind

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.	**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. **ETS2.A: Interdependence of Science, Engineering, and Technology** Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations.	**Patterns** Patterns in rates of change and other numerical relationships can provide information about natural systems.

*Students explore the atmosphere, biosphere, geosphere, and hydrosphere through PE 5-ESS2-1.

Observable features of student performance by the end of the course:

1. **Organizing data**
    a. Students organize data that represent the:
        i. distribution and ages of fossils and rocks,
        ii. continental shapes,
        iii. seafloor structures, and
        iv. age of oceanic crust (continental crust is billions of years old to give this context).
2. **Identifying relationships**
    a. Students analyze datasets about Earth features to identify relationships (including relationships that can be used to infer numerical rates of change, such as patterns in the ages of the sea floor).
3. **Interpreting data**
    a. Students use analyzed data to describe:
        i. regions of different continents that share similar fossils and similar rocks suggests in the geologic past the continents were once attached and have since separated;
        ii. the shapes of continents, which roughly fit together (like pieces in a jigsaw puzzle), suggest that those landmasses were once joined and have since separated;
        iii. the separation of continents by the formation of new seafloor at the center of the ocean is inferred by age patterns in oceanic crust that increase in age from the center to the edges of the ocean; and
        iv. the distribution of seafloor structures (for example: volcanic ridges at the center of ocean, trenches at the edges of continents, etc.) combined with the patterns in the ages of sea floor rocks (youngest at the ridge and oldest at the trench) supports interpretation that new crust forms at the ridges and then moves away from the ridges as new crust continues to form and that the oldest crust is being destroyed at seafloor trenches.

6-ESS2-3 Academic Language

Question/Sentence Stems

- I can observe (notice) the pattern of ________ presented in the data collected.
- The pattern seen in the collected data allows me to conclude (know) that ______.
- The observed pattern supports the conclusion that_____ is caused by _______, because .
- The pattern of ________is changing over time.
- The following predictions can be made about ______when using the pattern of __ found in the data.
- __________ are some similarities and differences among the above.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- continent
- continental crust
- continental shelf
- converge
- convergent plate boundary
- deep-sea trench
- diverge
- divergent plate boundary
- earthquake
- fossil
- fracture zone
- hotspot
- igneous rock
- magma
- metamorphic rock
- midocean ridge
- ocean trench
- oceanic crust
- plate boundary
- plate tectonics
- sea floor spreading
- seafloor structure
- sedimentary rock
- subduction (zone)
- tectonic process
- transform plate boundary
- uplift
- volcanic island arc
- volcanic rock
- volcano

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.	**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.	**Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.

Observable features of student performance by the end of the course:

1. **Components of the model**
   a. Students develop/use a model (conceptual, graphical, physical, etc.) and identify the relevant components, including:
      i. water (gas, liquid, solid),
      ii. solar energy,
      iii. gravity,
      iv. atmosphere,
      v. landforms, and
      vi. plants and other living things

2. **Relationships**
    a. Students develop/use a model to describe the relevant relationships between components, including:
        i. solar energy warms water on Earth causing some water to evaporate;
        ii. water vapor in the atmosphere cools, condenses and forms clouds (liquid water droplets), which can produce precipitation (for example: rain, snow, etc.);
        iii. gravity causes water on land to move downhill (for example: rivers, glaciers, etc.) and much of it eventually flows into oceans;
        iv. some liquid and solid water remains on land in the form of bodies of water, ice sheets, and glaciers; and
        v. transpiration.
3. **Connections**
    a. Students develop/use a model to account for how both solar energy and gravity drive water cycling between oceans, the atmosphere, and land including:
        i. Solar energy drives the movement of water from Earth (for example: oceans, landforms, animals, plants, etc.) into the atmosphere through transpiration and evaporation.
        ii. Water vapor in the atmosphere can cool and condense, forming clouds (liquid water droplets). Clouds produce rain, snow, and ice which are pulled back to Earth's surface by gravity.
        iii. Some precipitation falls back into the ocean and on land. On land, water can:
            1. be pulled down by gravity to form surface water (for example: streams, rivers, etc.) which usually join and generally flow back into the ocean;
            2. evaporate back into the atmosphere;
            3. transpiration;
            4. freeze (crystallize) and collect in frozen form, sometimes forming glaciers or ice sheets;
            5. be stored on land in bodies of water; and
            6. be stored below ground in aquifers.
    b. Students develop/use a model to describe the transfer of energy between water and the environment cause the phase changes that drive the water cycle through evaporation, transpiration, condensation, crystallization, and precipitation.
    c. Students develop/use a model to describe how gravity interacts with the different phases of water (limited to gas, liquid, solid) to drive water cycling between locations on Earth's surface and the atmosphere.

6-ESS2-4 Academic Language

Question/Sentence Stems

- When you put energy into this system ____________.
- The flow of energy causes ____________to occur in the system.
- In the system, the cycling of matter ___________.
- The matter in the system enters from___________.
- __ happens to matter as it moves within the system.
- When the matter leaves the system, it goes__________
- The energy is entering the system by ___________.
- The energy is leaving the system by ____________.
- In this system, energy is entering by ___________, doing ___________in the system, and leaving the system by ____________.
- The energy for_____________is from ____________.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- atmosphere
- biosphere
- cloud
- condensation
- crystallization
- cycle
- density
- Earth systems
- evaporation
- fog
- frost
- geosphere
- glacier
- gravity
- groundwater
- hydrosphere
- ice
- ice sheet
- landform
- pathway
- precipitation
- runoff
- snow
- solar energy
- temperature
- transpiration
- water
- water cycle
- water vapor

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.	**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. **ESS2.D: Weather and Climate** Because these patterns are so complex, weather can only be predicted probabilistically.	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems.

Observable features of student performance by the end of the course:

1. **Organizing Data**
    a. Students organize data that represent the:
        i. patterns and weather conditions in a specific area (for example: air/atmospheric/barometric pressure, humidity, temperature, wind speed, etc.) over time;

ii. relationship between:
    1. the distribution and movement of air masses,
    2. distribution of landforms and the effect these have on the movement of air masses,
    3. the effect of ocean temperatures on air masses,
    4. the effect of currents on the movement and temperature of air masses, and
    5. large-scale weather patterns and location/ movement of air masses, including patterns that develop between air masses (for example: the arrival of a cold front may cause thunderstorms, etc.).

2. **Identifying Relationships**
    a. Students analyze datasets to identify relationships (including relationships that can be used predict weather within probabilistic ranges) including:
        i. weather maps,
        ii. diagrams,
        iii. models, and
        iv. laboratory experiments.
3. **Interpreting Data**
    a. Students use analyzed data to provide evidence for how the motions and interactions of air masses result in changing weather conditions.

6-ESS2-5 Academic Language

Question/Sentence Stems

- __ caused the patterns I am observing.
- I know this because_____________.
- If _ happens, I predict that _____________________ will occur.
- Even though I cannot see ____________, it explains why ___________ is happening.
- When I change _____________ in the system, ___________ is affected.
- In this situation, even a small change of ____ can cause a big effect of ______.
- The evidence ___presented in the scenario supports the claim that ___ causes ____.
- In order to conclude that _____________ caused __________, the following evidence is needed_____________.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- air mass
- altitude
- anemometer
- atmosphere
- atmospheric pressure
- barometer
- barometric pressure
- cold front
- condensation
- density
- evaporation
- gravity
- hail
- high pressure
- humidity
- hygrometer
- jet stream
- low pressure
- millibar (mb)
- precipitation
- probability
- regions
- relative humidity
- sling psychrometer
- stationary front
- temperature
- thermometer
- thunderstorm
- tornado
- warm front
- weather conditions
- weather/wind vane
- wind
- wind direction
- wind speed

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.	**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. **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 throughocean currents.	**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.

*The dynamics of thermohaline circulation and the role of density in oceanic circulation is beyond the State Assessment Boundary for this PE. This directly conflicts with the first foundation statement in the DCI foundation box. Additionally, these mechanisms provide the opportunity for students to engage in sensemaking in the classroom and connect this PE to others in the grade (for example: 6-PS1-4, 6-PS3-4, 6-ESS2-5) and thus are included in the Performance Target.

*Traditionally, warm water currents are represented with red arrows and cool water currents are represented with blue arrows. However, other representations are also used, for example representing warm water currents with dashed arrows and cool water currents with solid arrows, etc. Ensure students pay close attention to symbol keys when interacting with maps.

Observable features of student performance by the end of the course:

1. **Components of the model**
    a. Students develop/use a model (conceptual, graphical, physical, etc.) and identify the relevant components (including inputs and outputs) of the system, including:
        i. the rotating Earth,
        ii. the atmosphere,
        iii. the ocean, including the relative rate of thermal energy transfer of water compared to land or air,
        iv. continents and the distribution of landforms on the surface of Earth,
        v. global distribution of ice,
        vi. distribution of living things, and
        vii. energy, including:
            1. solar energy as an input, and
            2. thermal energy existing in the atmosphere, water, land, and ice (as represented by temperature).
2. **Relationships**
    a. Students develop/use a model to describe the relevant relationships between components, including:
        i. differences in the distribution of solar energy and temperature changes, including:
            1. higher latitudes receive less solar energy per unit area than do lower latitudes, resulting in the temperature differences;
            2. oceans take longer to gain thermal energy and lose thermal energy slower than land;
            3. areas at higher elevations generally have a lower average temperature than areas at lower elevations; and
            4. features on the Earth's surface (for example: amount of solar energy reflected into the atmosphere at the poles, etc.), affect the amount of solar energy transferred into heat energy.
        ii. motion of ocean waters and air masses:
            1. fluids (limited to air, water) flow from areas of higher density to areas of lower density (convection),
                a. the main factor affecting the density of air is temperature,
                b. the main factors affecting density of water are salinity and temperature, and
                c. differences in density can cause fluids to convect horizontally and vertically.

iii. factors affecting the motion of wind and currents
    1. Earth's rotation causes oceanic and atmospheric flows to curve (Coriolis effect),
    2. geographical distribution of land affects the flow of ocean currents, and
    3. landforms affect atmospheric flow (for example: mountains deflect wind and/or force it to higher elevation, etc.).

iv. thermal energy transfer:
    1. thermal energy moves from areas of higher temperature to areas of lower temperature either through convection, radiation, or conduction,
    2. land heats and cools (the absorption and release of thermal energy) more quickly than water, and
    3. air heats and cools more quickly than land or water [Note: Air receives thermal energy by contact with land and water (conduction)].

3. Connections

a. Students develop/use a model to describe climate patterns, including:

i. On or near the equator climates are warmer because those areas receive more solar energy per unit area (more direct light). As latitudes increase, climates are generally cooler because those areas receive less solar energy per unit areas (less direct light).

ii. The general latitudinal pattern of drier and wetter climates is caused by the shift in the amount precipitation from rising warmer, moisture rich air and the sinking of dry cooler air, because:
    1. warmer air holds more moisture, therefore the climates in lower latitudes are generally wetter, and
    2. cooler air holds less moisture, therefore the climates in higher latitudes are generally drier.

iii. The pattern of climates is different in continental areas compared to the ocean. There is a pattern of greater and more rapid temperature change on land than in the ocean because water can absorb more solar energy for every degree change in temperature compared to land. At the center of land masses, this leads to conditions typical of continental climate patterns.

iv. Climates near large bodies of water (for example: marine coasts, etc.) have comparatively smaller temperature changes relative to locations in the center of landmasses. Land near the oceans exchange thermal energy through the air, resulting in smaller temperature changes. At the edges of landmasses, this leads to marine climates.

v. Climates at higher altitudes generally have lower temperatures because of the direct relationship between temperature and air pressure (given the same amount of thermal energy). Climates of locations at lower latitudes generally have warmer temperatures. Higher altitudes have lower air pressure than locations at lower altitudes and vice versa.

vi. Regional patterns of climate (for example: temperature, moisture, etc.) are related to a specific pattern of water and/or air circulation, including:

1. air and/or water moving from areas of high temperature, density, and/or salinity to areas of low temperature, density, and/or salinity,
2. Earth's rotation, which affects atmospheric and oceanic circulation,
3. transfer of thermal energy with the movement of matter (limited to convection), and
4. presence of landforms (for example: the rain shadow effect, etc.).

b. Students develop/use a model to describe the role of each of its components in producing a given regional climate.

6-ESS2-6 Academic Language

Question/Sentence Stems

- The key components of the system are____________.
- In the system, ______________ and _____________ are shown in the model.
- In the system, ____________ and ____________work together to___________.
- In the system, ______________ and ____________interact in ____________way.
- If you change ______________ in the system, __________ will occur.
- In the system, _____________ is not shown in the model. This is not shown because______.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- air current
- altitude
- atmosphere
- atmospheric circulation
- atmospheric pressure
- biosphere
- climate
- coastal region
- cold front
- condensation
- continent
- continental climate
- convection
- current
- density
- Earth systems
- equator
- evaporation
- fluid
- freshwater
- temperate zone
- temperature
- thermal energy
- thermohaline
- geosphere
- global
- humidity
- hydrosphere
- ice
- landform
- latitude
- marine climate
- North Pole
- ocean current
- oceanic circulation
- polar zone
- precipitation
- prevailing wind
- rotation
- salinity
- solar energy
- South Pole
- stationary front
- warm front
- tropical zone
- water cycle
- weather
- wind

ESS3 – Earth and Human Activity

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.	**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. **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.	**Patterns** Graphs, charts, and images can be used to identify patterns in data.

Observable features of student performance by the end of the course:

1. **Organizing data**
    a. Students organize data that:
        i. represent the type of natural hazard event and
        ii. features associated with that type of event, including:
            1. location,
            2. magnitude,
            3. frequency, and
            4. any associated precursor event or geologic forces.
2. **Identifying relationships**
    a. Students analyze datasets to identify and describe patterns, including:
        i. the location of natural hazard events relative to geographic and/or geologic features,
        ii. frequency of natural hazard events,
        iii. severity of natural hazard events,
        iv. damage caused by natural hazard events (for example: economic, structural, etc.), and
        v. location or timing of features and phenomena associated with natural hazard events (for example: aftershocks, flashfloods, etc.).
    b. Students describe similarities and differences among identified patterns.
3. **Interpreting data**
    a. Students use analyzed data to describe:
        i. areas that are susceptible to the natural hazard events, including areas designated as the greatest and least risk for severe events;
        ii. how frequently areas, including areas experiencing the highest and lowest frequency of events, are at risk;
        iii. what type of damage each area is at risk of during a given natural hazard event; and
        iv. what features, if any, occur before a given natural hazard event that can be used to predict the occurrence of the natural hazard event and when and where the event(s) can be observed.
    b. Students use patterns in data to:
        i. forecast the potential of a natural hazard event to affect an area, including:
            1. information on frequency and/or probability of occurrence,
            2. severity,
            3. likely location of the greatest damage, and
            4. precursors (if any) to the event.
    c. Students give at least three examples of the technologies that engineers have developed to mitigate the effects of natural hazards (for example: the design of buildings and bridges to resist earthquakes, warning sirens for tsunami's, storm shelters for tornadoes, levees along rivers to prevent flooding, etc.).

6-ESS3-2 Academic Language

Question/Sentence Stems

- I/We can observe (notice) the pattern of _______ presented in the data collected.
- I/We can observe (notice) the pattern of _______ in the data presented.
- The pattern seen in the collected data allows me/us to conclude (know) that _____.
- The observed pattern supports the conclusion that __ is caused by __, because ___.
- The pattern of _________ is changing over time.
- The following predictions can be made about ___ when using the pattern of ___ found in the data.

Terminology to Support Student Discourse about Phenomena

*Teaching words or concepts in isolation or prior to experiences that give context (frontloading) deprives students of sense-making opportunities that lead to a greater depth of conceptual understanding.

- ashfall
- atmosphere
- atmospheric pressure
- biosphere
- catchment
- climate change
- drought
- Earth systems
- earthquake
- earthquake magnitude
- flood
- frequency
- geosphere
- humidity
- hurricane
- hydrosphere
- interaction
- lahar (volcanic mudslide)
- lava flow
- levee
- liquefaction
- magnitude
- mass wasting
- mitigation
- natural hazard
- occurrence
- prediction
- pyroclastic flow
- reservoir
- satellite
- seismograph
- severe weather
- storm surge
- thunderstorm
- tropical storm
- tsunami
- volcanic eruption
- wildfire

References

Achieve. (2013). *Evidence Statements | Next Generation Science Standards*. https://www.nextgenscience.org/evidence-statements. Washington, DC.

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

Penuel, W. R. and Van Horne, K. (2018). *Prompts for Integrating Crosscutting Concepts into Assessment and Instruction*. https://stemteachingtools.org/assets/landscapes/STEM-Teaching-Tool-41-Cross-Cutting-Concepts-Promptsv2.pdf. Seattle, WA. University of Washington Institute for Science + Math Education.

South Carolina Department of Education. (2021). *South Carolina College- and Career-Ready Science Standards 2021*. https://ed.sc.gov/instruction/standards-learning/science/standards/south-carolina-college-and-career-ready-science-standards-2021-approved/. Columbia, SC.