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The Science of Energy

How types of energy exist in different forms; how energy is stored, transferred, and conserved within systems; and how energy interacts with matter.

Grade 6

SC.6.EN.1 Describe how energy moves within systems by identifying system boundaries, distinguishing between open and closed systems, and identifying potential and kinetic energy and their transformations.

SC.6.EN.1.1 Identify the characteristics of an open system.

Benchmark Clarifications:

Clarification 1: Instruction includes an open system as one in which both energy and matter can be exchanged.

Clarification 2: Instruction includes identifying and representing system boundaries and the transfer of energy and matter using diagrams and models to represent inputs and outputs. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.EN.1.2 Identify the characteristics of a closed system.

Students observe both systems over time.

Student Task(s) –

- Identify the system boundary for the covered container, describe what is inside and outside the system, and use evidence from the demonstration to explain whether energy and matter move into or out of the system.
- Create a labeled diagram of the system showing the system boundary and any observed movement of energy and matter. Use evidence from the demonstration to explain whether matter and energy moved across the boundary.

Benchmark Clarifications:

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Clarification 1: Instruction includes a closed system as one in which energy can be transferred but matter is not exchanged.

Clarification 2: Instruction includes identifying and representing system boundaries and the transfer of energy using diagrams and models to represent inputs and outputs. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.EN.1.3 Distinguish between an open and closed system.

Example: Students observe two real-world examples, a sealed food container and an open greenhouse with vents open, to identify the system boundary for each. Students create a model, drawing, or diagram showing how energy or matter move in each system.

Student Task(s) –

- Use the model, drawing, or diagram to identify which example is an open system and which is a closed system. Show how energy and matter move in each using arrows and labels.
- Explain one strength and one limitation of the model, drawing, or diagram in helping to distinguish between open and closed systems.

Benchmark Clarifications:

Clarification 1: Instruction includes distinguishing between open and closed systems using diagrams, models, or analogies.

Clarification 2: Instruction includes constructing, evaluating, and refining models that represent system interactions. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.EN.1.4 Identify and describe common forms of energy.

Example: A sixth-grade class tours its school campus and observes a flashlight in the front office, a speaker in the auditorium, a fan in the gym, a battery-powered light in a classroom,

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a microwave in the cafeteria, and sports equipment used during physical education. Students record observations and classify the type of energy represented by each item.

Student Task(s) –

- Identify the form of energy represented by each observed item.
- Use evidence from the observations to support the classification of each form of energy.
- Describe how scientists contributed to our understanding of one of the forms of energy identified during the campus investigation.

Benchmark Clarifications:

Clarification 1: Instruction includes light (electromagnetic), sound, thermal, mechanical, chemical, electrical, and nuclear energy.

Clarification 2: Instruction includes recognizing that light is a form of electromagnetic energy and that nuclear energy is associated with energy stored in the nucleus of an atom. Refer to the Timeline of Key Accomplishments Supporting Mastery of Energy, Matter, and Force and Motion Benchmarks.

SC.6.EN.1.5 Examine instances of potential and kinetic energy as observed within a system.

Example: Students in a sixth-grade class view a video of a skateboard rider moving down a ramp and a swing moving through its motion at a playground.

Student Task(s) –

- Identify examples of potential and kinetic energy in each system.
- Describe evidence that an object has potential or kinetic energy.
- Compare how the objects differ in position and motion.

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- Use evidence from observations or models to explain how the energy of the moving object differs at various points in its motion.

Benchmark Clarifications:

Clarification 1: Instruction includes examples of stored energy such as gravitational, chemical, elastic and nuclear energy.

Clarification 2: Instruction includes examples of energy associated with motion and energy transfer, such as mechanical motion, thermal energy, sound, electrical energy, and electromagnetic radiation.

Clarification 3: Instruction includes mechanical energy as a combination of potential and kinetic energy.

Clarification 4: Instruction includes identifying and comparing potential, kinetic, and mechanical energy within real-world systems using observations.

Clarification 5: Instruction includes developing and using models to represent energy forms and transformations within systems. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes conducting investigations and collecting evidence to identify energy forms and transformations within systems. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.EN.2 Describe how electromagnetic energy behaves by identifying patterns in the electromagnetic spectrum, recognizing visible light as the portion detected by humans, and explaining how reflection influences observed color and energy absorption.

SC.6.EN.2.1 Describe the parts of the electromagnetic spectrum.

Example: Students examine infrared and visible-light images used during Florida hurricane forecasting. They then use the model to compare different regions of the electromagnetic spectrum.

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Student Task(s) –

- Identify visible light as one region of the electromagnetic spectrum.
- Use the electromagnetic spectrum model to identify and compare different types of electromagnetic waves.
- Compare the wavelengths and frequencies of electromagnetic waves.
- Describe the relationship between wavelength and frequency.
- Use evidence from the images and the spectrum model to explain that visible light is one type of electromagnetic wave.

Benchmark Clarifications:

Clarification 1: Instruction includes the parts of the electromagnetic spectrum: radio waves, microwaves, infrared, visible light, ultraviolet, x-rays, and gamma rays.

Clarification 2: Instruction includes qualitative differences in wavelength and frequency among parts of the electromagnetic spectrum.

Clarification 3: Instruction includes analyzing patterns in wavelength and frequency across the electromagnetic spectrum. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 4: Instruction includes interpreting models of the electromagnetic spectrum to identify relationships among its parts. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes how scientists such as William Herschel, Johann Wilhelm Ritter, and James Clerk Maxwell contributed to the understanding of regions of the electromagnetic spectrum. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.EN.2.2 Explain that visible light is the portion of the electromagnetic spectrum detectable by humans.

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Example: Students use a model of the electromagnetic spectrum to investigate the portion that can be detected by the human eye. Students compare visible light with electromagnetic waves outside the visible range and examine how the colors of visible light correspond to different wavelengths.

Student Task(s) –

- Identify visible light as one portion of the electromagnetic spectrum.
- Identify the range of colors represented within visible light.
- Compare the wavelengths associated with different colors of visible light.
- Identify examples of electromagnetic radiation that humans cannot detect with their eyes.
- Explain that human vision detects only a limited range of electromagnetic wavelengths.

Benchmark Clarifications:

Clarification 1: Instruction includes wavelengths detectable by the human eye.

Clarification 2: Instruction includes the portion of the visible spectrum detectable by humans, represented by colors of differing wavelengths: red, orange, yellow, green, blue, indigo, and violet.

SC.6.EN.2.3 Describe how reflection of light occurs when electromagnetic energy bounces off a surface.

Example: On a sunny day at a Florida beach, a student notices sunlight reflecting off the ocean water, a mirror in a nearby beach house, and a car windshield. Students compare how light interacts with each surface and investigate reflection using a light source and different materials.

Student Task(s) –

- Identify surfaces that reflect light.
- Observe and record what happens when light strikes different surfaces.

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- Compare how light reflects from smooth and less-smooth surfaces.
- Describe reflection as electromagnetic energy bouncing off a surface.
- Use observations from the investigation to explain how reflection occurs.

Benchmark Clarifications:

Clarification 1: Instruction includes conducting investigations and collecting evidence to observe reflection of light from different surfaces. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.EN.2.4 Describe the role of reflection in human sight.

Example: Students investigate how they see objects in a dim classroom using a flashlight, a book and a mirror. Students observe the path of light from the flashlight to the object and from the object to their eyes.

Student Task(s) –

- Trace the path of light from the source to the object and from the object to the observer's eyes.
- Use observations from the investigation to explain how light travels between the source, object, and observer.
- Construct an evidence-based explanation for how reflected light allows an observer to see an object.

Benchmark Clarifications:

Clarification 1: Instruction includes the observed color as a wavelength of reflected light.

Clarification 2: Instruction includes that white objects reflect all wavelengths of visible light.

Clarification 3: Instruction includes that black objects absorb all wavelengths of visible light.

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Clarification 4: Instruction includes using conceptual models to explain how reflected light contributes to observed color and sight. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Grade 7

SC.7.EN.1 Analyze how energy is stored, transferred, and conserved within systems by defining system boundaries, modeling energy movement, relating matter transfer to energy flow in open systems, examining system interactions and feedbacks, and explaining relationships among potential, kinetic, and mechanical energy, including conduction, convection, and radiation.

SC.7.EN.1.1 Represent energy movement within systems using models.

Example: Students investigate how energy moves through a battery-powered flashlight. They examine the battery, electrical circuit and light-producing bulb and use a model to represent how energy moves through the system.

Student Task(s) –

- Identify the system and its components.
- Use a model to represent energy entering, leaving, and moving within the system.
- Explain what the model shows about energy movement.
- Evaluate one strength and one limitation of the model.

Benchmark Clarifications:

Clarification 1: Instruction includes identifying energy entering, leaving, and remaining within a system.

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Clarification 2: Instruction includes developing and using arrows, labeled diagrams, and flow representations to model energy movement within systems. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.EN.1.2 Describe system boundaries and identify what is inside and outside a system.

Example: Students examine several familiar systems, such as a sealed cooler, a home aquarium and a covered pot of soup, and investigate how a system boundary defines what is inside and outside the system.

Student Task(s) –

- Draw and label the boundary for each system.
- Identify what is inside and outside each system.
- Explain how changing the boundary changes what is considered part of the system.

Benchmark Clarifications:

Clarification 1: Instruction includes developing and using diagrams and labeled representations to model system boundaries. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.EN.1.3 Explain how energy moves into, out of, and within open and closed systems.

Example: A seventh-grade class investigates how energy moves in different systems. Students compare a sealed terrarium and an open school garden bed. Students observe the terrarium and open garden bed over time and use diagrams to identify possible movements of energy and matter across system boundaries.

Student Task(s) –

- Develop a diagram of the terrarium and open garden bed.
- Use arrows to show energy movement.

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- Use evidence from the diagrams and observations to explain how energy transfer differs between the open and closed systems.

Benchmark Clarifications:

Clarification 1: Instruction includes the differences in energy movement between open and closed systems.

Clarification 2: Instruction includes cause and effect relationships between system type and energy transfer.

Clarification 3: Instruction includes developing and using diagrams or models to represent energy movement into, out of, and within systems. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.EN.1.4 Explain how matter transfers affect the flow of energy within a system.

Example: A seventh-grade class observes a compost bin over time and collects evidence of materials entering, leaving, and changing within the system.

Student Task(s) –

- Develop and use a model to show how matter moves into and out of the compost bin.
- Describe how these matter transfers affect the flow of energy within the system.

Benchmark Clarifications:

Clarification 1: Instruction includes distinguishing between energy transfer and movement of matter in systems.

Clarification 2: Instruction includes that movement of matter into or out of a system can affect energy flow in open systems.

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Clarification 3: Instruction includes developing and using models to represent relationships between matter movement and energy flow. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.EN.1.5 Explain how system type affects energy conservation within it.

Example: A seventh-grade class investigates energy conservation by planting identical seeds in two different systems. One seed is placed inside a closed terrarium with a sealed lid, while another is planted in an open container exposed to the surrounding environment. Both systems receive the same amount of sunlight. Over several weeks, students collect data on temperature, moisture, and plant growth in both systems and compare patterns observed over time.

Student Task(s) –

- Use the data collected from the two seed-growing systems to compare energy retention in the open and closed systems.
- Develop a model illustrating energy movement.
- Explain how system type affects energy conservation and plant growth.
- Construct a claim about which system retained energy more effectively and support the claim with evidence from the investigation.

Benchmark Clarifications:

Clarification 1: Instruction includes energy conservation within system boundaries.

Clarification 2: Instruction includes how energy transfer between a system and its surroundings affects the amount of energy retained within the system.

Clarification 3: Instruction includes comparing energy retention in open and closed systems.

Clarification 4: Instruction includes analyzing patterns in energy transfer, conservation, and retention using data. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Clarification 5: Instruction includes developing and using models to explain energy conservation within systems. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes conducting investigations and collecting evidence to observe how system types affect energy conservation. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.EN.1.6 Explain relationships between potential energy, kinetic energy, and mechanical energy within a system.

Example: Students investigate a roller coaster car moving along a track. They focus on how the car's position and motion affect the energy within the system.

Student Task(s) –

- Identify where the roller coaster has greater potential energy and where it has greater kinetic energy based on its position and motion.
- Use observations or a model to explain how potential and kinetic energy change as the roller coaster moves through the system.
- Develop and use a model to describe the relationship among the roller coaster's height, speed, potential energy, kinetic energy, and mechanical energy.

Benchmark Clarifications:

Clarification 1: Instruction includes mechanical energy as the combination of potential and kinetic energy.

Clarification 2: Instruction includes examples of energy changes associated with motion, position, and deformation of objects.

Clarification 3: Instruction includes developing and using models to explain relationships among potential, kinetic, and mechanical energy within a system. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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SC.7.EN.1.7 Explain how energy is conserved, transferred, and transformed within systems.

Example: A seventh-grade class investigates how energy is conserved, transferred, and transformed in a small plant-growing enclosure used in a school garden. Students place thermometers in different locations and collect temperature data throughout the day. Students observe temperature changes in different parts of the enclosure and investigate possible mechanisms of energy transfer.

Student Task(s) –

- Collect and organize temperature data from the enclosure and its surroundings.
- Use evidence from the investigation to classify different mechanisms of energy transfer.
- Develop a model explaining how energy is transferred and transformed within the system and between the system and its surroundings.
- Use evidence from the investigation to explain how the results support the principle of energy conservation and relate to the work of James Prescott Joule.

Benchmark Clarifications:

Clarification 1: Instruction includes energy transfer through conduction, convection, and radiation.

Clarification 2: Instruction includes distinguishing between thermal conductivity, which describes how readily thermal energy transfers through a material, and electrical conductivity, which describes how readily electric charge moves through a material.

Clarification 3: Instruction includes energy conservation within systems before and after transformations.

Clarification 4: Instruction includes collecting, organizing, and interpreting data to identify patterns in energy transfer and conservation. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Clarification 5: Instruction includes conducting investigations to examine energy transfer and conservation within systems. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes examining historical developments that contributed to scientific understanding of energy transfer and conservation. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.EN.2 Analyze how waves transfer energy and interact with matter by relating wavelength, frequency, amplitude, and energy, explaining the organization of the electromagnetic spectrum, and modeling wave interactions across different media.

SC.7.EN.2.1 Describe waves as energy-carrying disturbances.

Example: Students use a coiled spring toy to model a wave traveling from one end to the other and observe that the disturbance moves through the toy while the individual coils move back and forth around their starting positions. Students compare the movement of the disturbance with the movement of the material.

Student Task(s) –

- Identify the disturbance moving through the coiled spring toy.
- Describe how energy is transferred from one location to another.
- Observe and describe the motion of individual coils as the wave travels.
- Use observations from the model to explain what moves through the spring and what does not.
- Use a model to represent a wave as an energy-carrying disturbance.
- Identify a limitation of the toy model as a representation of a wave.

Benchmark Clarifications:

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Clarification 1: Instruction includes mechanical waves and electromagnetic waves.

Clarification 2: Instruction includes that waves transfer energy without transferring matter from one location to another.

Clarification 3: Instruction includes evaluating models of waves and their limitations. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.EN.2.2 Describe wave characteristics including wavelength, amplitude, and frequency.

Example: Students use a wave model to investigate waves with different wavelengths and frequencies. They measure the distance between repeating points on each wave and count the number of waves that pass a fixed point in each amount of time.

Student Task(s) –

- Identify the wavelength of a wave.
- Determine the amplitude and frequency of a wave.
- Use data to identify patterns among wavelength, amplitude, frequency, and energy.
- Explain how changes in wavelength and frequency relate to changes in energy.

Benchmark Clarifications:

Clarification 1: Instruction includes wavelength as the distance between repeating points, such as from crest to crest or trough to trough in transverse waves and compression to compression in longitudinal waves.

Clarification 2: Instruction includes frequency as the number of waves per second (Hertz).

Clarification 3: Instruction includes interpreting relationships among wavelength, amplitude, frequency, and energy.

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Clarification 4: Instruction includes analyzing numerical patterns and relationships among wavelength, amplitude, frequency, and energy. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes using models or data displays to describe wave characteristics. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.EN.2.3 Explain how the electromagnetic spectrum is organized.

Example: A seventh-grade class is studying how different types of electromagnetic waves are used in everyday life. Students examine a model of the electromagnetic spectrum that includes radio waves, microwaves, infrared light, visible light, ultraviolet light, X-rays, and gamma rays. Students compare the wavelengths, frequencies, and energy levels represented in the model and identify patterns across the spectrum.

Student Task(s) –

- Use a model of the electromagnetic spectrum to identify patterns among wavelength, frequency, and energy.
- Create a diagram showing the order of electromagnetic waves.
- Explain the patterns observed across the spectrum.

Benchmark Clarifications:

Clarification 1: Instruction includes wavelength, frequency and energy relationships across the electromagnetic spectrum.

Clarification 2: Instruction includes the direct relationship between frequency and energy and the inverse relationship between wavelength and frequency.

Clarification 3: Instruction includes interpreting models of the electromagnetic spectrum to explain wavelength, frequency, and energy relationships. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Clarification 4: Instruction includes examining historical developments that contributed to scientific understanding of electromagnetic radiation and the electromagnetic spectrum. Refer to Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.EN.2.4 Model how waves interact with matter.

Example: Students observe how sound and light interact with materials found around a middle school courtyard or outdoor learning area. They examine how waves interact with building walls, windows, pavement, grass, trees, and covered walkways and use models to explain and predict wave interactions with different materials.

Student Task(s) –

- Investigate how sound and light interact with different materials and record observations.
- Use the model to predict how the wave would interact with a different material.
- Construct an explanation supported by evidence from the investigation and model.
- Develop and use a model to explain how a wave interacts with a selected material.

Benchmark Clarifications:

Clarification 1: Instruction includes mechanical waves and electromagnetic waves.

Clarification 2: Instruction includes reflection, refraction, absorption, and transmission.

Clarification 3: Instruction includes developing, using, and evaluating models of wave interactions, including their limitations. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 4: Instruction includes investigating wave interactions and analyzing results from those investigations. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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SC.7.EN.2.5 Compare mechanical and electromagnetic waves.

Example: Students investigate how information is transmitted using a handheld radio and a coiled spring model to compare the behavior of two different types of waves.

Student Task(s) –

- Identify each wave as mechanical or electromagnetic.
- Compare the two waves based on how they travel and how they transfer energy.
- Use observations from the models to identify and explain the similarities and differences between the two types of waves.

Benchmark Clarifications:

Clarification 1: Instruction includes that mechanical waves require a medium and can be transverse or longitudinal.

Clarification 2: Instruction includes that electromagnetic waves do not require a medium and are transverse.

Clarification 3: Instruction includes comparing how mechanical and electromagnetic waves transfer energy.

Clarification 4: Instruction includes developing, using, and evaluating models of mechanical and electromagnetic waves, including their limitations. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes investigating mechanical and electromagnetic waves and analyzing results from those investigations. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.EN.2.6 Investigate wave behavior in different media.

Example: A seventh-grade class investigates how sound waves travel through different media. Students design an investigation using a waterproof speaker and test how well

sound travels through a desk, water in a container, and air. They record observations about how quickly and clearly the sound reaches the listener in each medium.

Student Task(s) –

- Analyze the data collected to identify patterns in wave speed.
- Explain how the properties of each medium affect wave behavior.

Benchmark Clarifications:

Clarification 1: Instruction includes differences in wave speed across solids, liquids, and gases.

Clarification 2: Instruction includes relationships between medium properties and wave speed relating properties of different media to differences in wave speed.

Clarification 3: Instruction includes designing and conducting investigations and analyzing data to identify patterns in wave behavior across different media. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Grade 8

SC.8.EN.1 Explain how energy is transferred and conserved within and between systems by applying the Law of Conservation of Energy and analyzing how thermal energy and energy transformations influence system behavior and efficiency.

SC.8.EN.1.1 Analyze energy transfers and transformations within open and closed systems.

Example: Students investigate the operation of a battery-powered toy car and use observations, measurements, and models to examine energy changes within the system. Students use an energy flow diagram or energy bar model to represent the transfers and transformations.

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Student Task(s) –

- Identify energy inputs and outputs and describe energy transfers, and transformations within the system.
- Represent energy changes using an energy flow diagram or energy bar model.
- Use evidence from the model or data to explain patterns in energy transfers and transformations.

Benchmark Clarifications:

Clarification 1: Instruction includes energy inputs, outputs, transfers, and transformations within a system.

Clarification 2: Instruction includes open and closed systems and how system boundaries affect energy conservation.

Clarification 3: Instruction includes analyzing quantitative and qualitative patterns in energy transfer and transformation using data. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 4: Instruction includes developing and using diagrams or models to analyze energy transfer and transformation within systems. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes designing and conducting investigations to analyze energy transfers and transformations within systems. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.EN.1.2 Apply the Law of Conservation of Energy to explain energy transformations.

Example: During hurricane season in Florida, a family uses a battery powered flashlight from an emergency kit when the power goes out. The flashlight produces light while the bulb becomes warm before eventually dimming as the battery power drains. Students analyze the energy transformations occurring in the flashlight and consider how energy is transferred to the surroundings.

Student Task(s) –

- Identify the energy transformations that occur while the flashlight is operating.
- Identify evidence that energy is transferred to the surroundings.
- Use the Law of Conservation of Energy to explain what happens to the energy in the system.
- Use evidence from the scenario to support the explanation.

Benchmark Clarifications:

Clarification 1: Instruction includes energy conservation across multiple transformations within a system.

Clarification 2: Instruction includes energy transferred to the surroundings as thermal energy due to friction or electrical resistance.

Clarification 3: Instruction includes examples of complex systems such as machines, energy chains, and systems with energy losses to the surroundings.

Clarification 4: Instruction includes analyzing quantitative and qualitative patterns in energy transfer and transformation using data. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes conducting investigations and using evidence to explain energy conservation. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes examining historical developments that contributed to the Law of Conservation of Energy. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.EN.1.3 Explain how gravitational and elastic potential energy change within real-world systems.

Example: Students investigate a skateboarder moving on a ramp. They examine the skateboarder's position at different points on the ramp and use a model to represent

changes in gravitational potential energy and kinetic energy. Students also investigate an object such as a compressed spring and compare how its stored energy changes when the object is deformed and released.

Student Task(s) –

- Identify examples of gravitational and elastic potential energy.
- Compare how position and deformation affect the amount of stored energy.
- Describe how potential energy changes as an object moves within the system.
- Relate changes in potential energy to changes in kinetic energy.
- Use a model to explain changes in potential energy and kinetic energy.

Benchmark Clarifications:

Clarification 1: Instruction includes gravitational and elastic potential energy in real-world systems.

Clarification 2: Instruction includes relating changes in potential energy to corresponding changes in kinetic energy.

Clarification 3: Instruction includes analyzing how position, configuration, or deformation affect stored energy.

Clarification 4: Instruction includes developing and using models to represent changes in potential energy within systems. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.EN.1.4 Analyze the energy transfer and transformation of electric circuits.

Example: Students investigate simple, series and parallel circuits containing components such as bulbs, buzzers and small motors. They observe the operation of the circuits and record the effects produced by different components.

Student Task(s) –

- Identify the circuit configuration being investigated.

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- Trace the path of energy through each circuit.
- Identify where electrical energy is transferred within the circuit.
- Identify the form or forms of energy produced by each circuit component.
- Compare energy transfer and transformation in simple, series and parallel circuits.
- Use a circuit model to represent energy transfer and transformations.
- Use observations or data from the investigation to support conclusions about how electrical energy is transformed.

Benchmark Clarifications:

Clarification 1: Instruction includes simple, series, and parallel circuits.

Clarification 2: Instruction includes electrical energy transfer from a source to componentsin a circuit.

Clarification 3: Instruction includes transformations from electrical energy to other forms such as light, thermal, mechanical, and sound energy.

Clarification 4: Instruction includes developing and using circuit models to explain energy transfer and transformation. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes conducting investigations and using evidence to explain energy transfer and transformation of electric circuits. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.EN.1.5 Explain the relationship between kinetic energy, mass, and speed.

Example: After a hurricane in Tallahassee, clean-up crews move fallen branches and debris. One wheelbarrow has a mass of 20 kilograms and moves at 3 meters per second, while another has a mass of 40 kilograms and moves at 2 meters per second. Students calculate and compare the kinetic energy of the two wheelbarrows and investigate how changing mass or speed affects the amount of kinetic energy.

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Student Task(s) –

- Identify the mass and speed of each moving object.
- Calculate the kinetic energy when the mass and speed are provided.
- Compare the kinetic energy of the two objects.
- Solve for mass or speed when the kinetic energy and the other variable are provided.
- Explain how changes in mass and speed affect kinetic energy.
- Use appropriate units and interpret the calculated results in the context of the scenario.

Benchmark Clarifications:

Clarification 1: Instruction includes that kinetic energy increases as mass or speed increases.

Clarification 2: Instruction includes calculating kinetic energy, mass, or speed when the other two variables are provided.

Clarification 3: Instruction includes using units appropriately and interpreting results in real-world scenarios.

Clarification 4: Instruction includes analyzing mathematical relationships among mass, speed, and kinetic energy to solve problems and interpret results. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.EN.2 Explain how waves transfer energy and interact with matter by relating wavelength, amplitude, frequency, and energy to the behavior of mechanical and electromagnetic waves, analyzing how electromagnetic radiation transmits energy and information, and explaining wave interactions across different media.

SC.8.EN.2.1 Analyze relationships among wavelength, amplitude, frequency, and energy.

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Example: An eighth-grade class is studying the science of music using a digital sound analyzer. Students compare the sound waves produced by a bass guitar, a piano, and a piccolo. The analyzer displays graphs showing the wavelength, amplitude, frequency, and energy of the sound waves. Students compare graphs showing wavelength, amplitude, frequency, and energy for different instruments and identify patterns among the variables.

Student Task(s) –

- Analyze the sound wave graphs from the musical instruments.
- Identify patterns between wavelength, amplitude, and frequency.
- Use the data to describe the relationships among wavelength, amplitude, frequency, and energy.
- Predict how changes in wavelength, amplitude, or frequency would affect the energy of the wave.
- Create a model or diagram illustrating the relationships among wavelength, amplitude, frequency, and energy.

Benchmark Clarifications:

Clarification 1: Instruction includes qualitative and quantitative relationships among wavelength, amplitude, and frequency and their influence on wave energy.

Clarification 2: Instruction includes interpreting graphs and models representing wavelength, amplitude, frequency, and energy relationships.

Clarification 3: Instruction includes predicting energy changes based on changes in wavelength, amplitude, or frequency.

Clarification 4: Instruction includes analyzing mathematical relationships among wavelength, amplitude, frequency, and energy using graphs and data. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes creating models or diagrams to explain the relationships among wavelength, amplitude, frequency, and energy. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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SC.8.EN.2.2 Analyze how waves transfer energy through interactions with matter.

Example: Students compare how sunlight interacts with school campus surfaces such as pavement, grass, windows, and other reflective or energy-collecting surfaces.

Student Task(s) –

- Identify how sunlight interacts with each material.
- Compare how energy is distributed among the different interactions.
- Identify patterns in the data.
- Use evidence from the data to explain how the interaction between light and a material affects energy transfer.

Benchmark Clarifications:

Clarification 1: Instruction includes energy transfer through reflection, absorption, refraction, and transmission.

Clarification 2: Instruction includes comparing energy distribution across different wave interactions.

Clarification 3: Instruction includes biological effects of ultraviolet radiation.

Clarification 4: Instruction includes analyzing data to explain energy transfer through wave interactions. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes investigating wave interactions and using evidence to explain energy transfer. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.EN.2.3 Apply wave concepts to explain real-world phenomena.

Example: At a Florida middle school football game, students notice that the home team's bright green jerseys look vibrant in the sunlight while the visiting team's dark blue jerseys

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appear much darker. Students investigate how sunlight interacts with the two jersey materials and examine the colors observed under different lighting conditions. They use evidence from the investigation to develop an explanation for why the jerseys appear the colors they do.

Student Task(s) –

- Identify evidence of how light interacts with each jersey.
- Apply wave concepts to explain why jerseys appear as different colors.
- Use evidence from the investigation to explain how properties of light affect what an observer sees.

Benchmark Clarifications:

Clarification 1: Instruction includes evaluating how wave properties influence the behavior of systems and observed phenomena.

Clarification 2: Instruction includes constructing written scientific explanations supported by evidence and scientific reasoning.

Clarification 3: Instruction includes developing and using models of wave behavior to explain real-world phenomena. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 4: Instruction includes conducting investigations and using evidence to evaluate explanations of wave phenomena. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

The Science of Matter

How matter is composed of atoms and particles, how physical and chemical changes can be identified using evidence, and how elements and substances are organized and classified.

Proposed DRAFT Standards

Grade 6

SC.6.M.1 Develop and apply an understanding of matter as atoms and particles whose structure, arrangement, and interactions determine its properties and states, including how matter changes with energy and how its properties can be measured and modeled.

SC.6.M.1.1 Describe the structure of atoms.

Example: Students examine several models of an atom and use evidence from each model to describe how scientists represent the structure of an atom. Students then construct a simple model showing the nucleus and the regions where electrons are represented and discuss how the model represents an atom rather than showing the atom as it actually appears.

Student Task(s) –

- Identify the major parts represented in an atomic model.
- Use a model to describe the basic structure of an atom.
- Explain the strengths and limitations of an atomic model.

Benchmark Clarifications:

Clarification 1: Instruction includes that models of atomic structure are simplified representations developed over time based on scientific evidence.

Clarification 2: Instruction is limited to describing the basic structure of an atom as consisting of a nucleus containing protons and neutrons and electrons occupying the space surrounding the nucleus.

Clarification 3: Instruction includes developing and using conceptual and structural models to represent atomic structure. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Clarification 4: Instruction includes examining how atomic models have changed as scientific understanding has advanced. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.M.1.2 Compare the charge, location, and mass of subatomic particles.

Example: Students examine models of atoms and use reference information to compare protons, neutrons and electrons. They organize information about each particle's charge, location and relative mass and use a model of an atom to show where each particle is found.

Student Task(s) –

- Compare the charge, location, and relative mass of protons, neutrons, and electrons.
- Organize the comparisons using a table or model.
- Explain similarities and differences among the particles.

Benchmark Clarifications:

Clarification 1: Instruction includes that the appropriate unit of measurement for the mass of atoms is the atomic mass unit (AMU).

Clarification 2: Instruction is limited to comparing the relative charge, location and relative mass of protons, neutrons and electrons.

Clarification 3: Instruction excludes electron configurations and calculating atomic mass, isotopic mass or detailed subatomic particle masses.

Clarification 4: Instruction includes developing and using models to compare the charge, location, and relative mass of subatomic particles. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.M.1.3 Explain relationships among atoms, elements, molecules, and compounds.

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Example: Students examine models representing oxygen in the air, water, and table salt. They compare the models to explain how atoms can exist as elements and combine to form molecules and compounds.

Student Task(s) –

- Compare the particle arrangements represented in models of oxygen, water, and table salt.
- Use evidence from the models to describe the relationships among atoms, elements, molecules and compounds.
- Explain how differences in particle arrangement distinguish elements, molecules, and compounds.
- Analyze how the models support understanding of the structures of matter.
- Evaluate one strength and one limitation of the particle model.

Benchmark Clarifications:

Clarification 1: Instruction includes using conceptual models to represent relationships among atoms, elements, molecules, and compounds.

Clarification 2: Instruction includes the strengths and limitations of particle and atomic models used to represent matter.

Clarification 3: Instruction excludes chemical bonding or molecular formulas.

Clarification 4: Instruction includes developing and using models to explain relationships among forms of matter. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.M.2 Explain how the properties of matter can be measured and used to describe substances.

SC.6.M.2.1 Explain that density is the ratio of the mass to volume.

Example: Students investigate several solid objects with different masses and volumes. They measure the mass and volume of each object, calculate its density and compare the density values to determine which objects are more or less dense.

Student Task(s) –

- Measure or use provided measurements for the mass and volume of each object.
- Calculate the density of each object using the mass-to-volume relationship.
- Record the measurements and calculated densities in a data table.
- Construct a claim about which object is most dense and support the claim using measurements and calculations.

Benchmark Clarifications:

Clarification 1: Instruction includes the formula for density and appropriate units of measurement, such as grams per milliliter.

Clarification 2: Instruction includes that density determines whether objects sink or float.

Clarification 3: Instruction includes calculating density from measured mass and volume and comparing substances using density values.

Clarification 4: Instruction includes using proportional relationships and density calculations to analyze and compare substances. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes collecting and analyzing measurement data to determine density. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.M.3 Explain how the arrangement and motion of particles determine the states of matter and how energy changes these states.

Proposed DRAFT Standards

SC.6.M.3.1 Distinguish solids, liquids, gases, and plasma in terms of particle arrangement and kinetic energy.

Example: Students observe ice, liquid water, steam, and images of plasma in lightning or fluorescent lights. They compare particle models representing each state and identify patterns in particle arrangement and kinetic energy.

Student Task(s) –

- Compare the relative motion and kinetic energy of particles in each state.
- Use the models to identify similarities and differences among the four states.
- Develop or revise a particle model to represent one of the states of matter and explain one strength and one limitation of the model.

Benchmark Clarifications:

Clarification 1: Instruction includes using particle models to compare particle arrangement, motion, and relative kinetic energy in solids, liquids, gases, and plasma.

Clarification 2: Instruction includes developing and using particle models to represent states of matter. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.M.3.2 Explain that the state of matter can change when energy is absorbed or released.

Example: Students investigate what happens to a sample of water as it is heated and then cooled. They observe changes in the sample, record temperature measurements and examine a temperature-time graph to identify when the water changes state. They also watch short videos of additional examples including sublimation, such as ice changing directly into water vapor, and deposition, such as water vapor changing directly into ice. Students use particle models to represent how the particle motion and spacing change as energy is absorbed or released.

Student Task(s) –

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- Identify the phase change occurring as the water is heated or cooled.
- Compare particle motion and spacing before, during and after the phase change.
- Identify whether energy is being absorbed or released during each phase change.
- Use evidence from the graph and particle model to explain why a phase change occurred.

Benchmark Clarifications:

Clarification 1: Instruction includes freezing, melting, condensation, vaporization, sublimation, and deposition.

Clarification 2: Instruction includes that absorbing energy increases particle motion and spacing, while releasing energy decreases particle motion and spacing.

Clarification 3: Instruction includes that when the state of matter changes, the chemical composition does not.

Clarification 4: Instruction includes interpreting temperature-time graphs to identify phase changes and patterns in energy transfer. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes using particle models to explain phase changes and energy transfer. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Grade 7

SC.7.M.1 Analyze physical and chemical properties of matter and use evidence to identify and classify substances.

SC.7.M.1.1 Differentiate between physical and chemical properties of matter.

Example: Students examine data collected from investigations of iron nails, aluminum foil, table salt, and sulfur. The data include observations and measurements of color, density, state of matter, solubility, conductivity, and magnetism, as well as evidence of how the samples respond when exposed to oxygen or an acid. Students analyze the evidence and construct explanations to determine whether each observed characteristic represents a physical or chemical property.

Benchmark Clarifications:

Clarification 1: Instruction includes physical properties: color, density, volume, state of matter, hardness, melting and boiling point, solubility, conductivity, and magnetism.

Clarification 2: Instruction includes chemical properties: flammability, toxicity, corrosion, reactivity with acids, and reactivity with oxygen.

Clarification 3: Instruction includes using observations and data to identify and classify physical and chemical properties. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.M.1.2 Explain how size-independent properties may be used to identify substances.

Example: Students are given samples of several substances in different amounts. They collect and analyze data for properties such as density, boiling point, solubility, conductivity, or magnetism. Students compare the property data for samples of different sizes and look for properties that remain consistent regardless of the amount of substance tested.

Student Task(s) –

- Compare the properties of samples that contain different amounts of the same substance.
- Identify properties that remain constant as sample size changes.
- Identify properties that change when the amount of substance changes.

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- Analyze provided data to determine which properties could be used to distinguish one substance from another.
- Explain why a size-independent property can be useful for identifying a substance.

Benchmark Clarifications:

Clarification 1: Instruction includes size-independent physical properties: density, boiling point, solubility, conductivity, and magnetism.

Clarification 2: Instruction includes identifying patterns in properties that remain constant regardless of sample size.

Clarification 3: Instruction includes analyzing data and identifying patterns in size-independent properties to distinguish and identify substances. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 4: Instruction includes using observations and data to explain why size-independent properties can be useful for identifying substances. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.M.1.3 Provide evidence that density may be used to identify an unknown substance.

Example: Students are given an unknown metal sample and a reference table containing the densities of several pure metals. They measure the mass and volume of the unknown sample and calculate its density. They compare their calculated density with the densities in the reference table to determine which substance is the most likely identity of the unknown sample.

Student Task(s) –

- Construct a claim identifying an unknown substance and support the claim with density evidence.
- Provide evidence that density may be used to identify an unknown substance.

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Benchmark Clarifications:

Clarification 1: Instruction includes the formula for density and the appropriate units of measurement, such as grams per milliliter.

Clarification 2: Instruction includes calculations to determine mass, volume, or density when the other two quantities are provided.

Clarification 3: Instruction is limited to using provided densities of pure substances for identification purposes and excludes memorization of densities of specific substances.

Clarification 4: Instruction includes constructing and supporting claims about the identity of an unknown substance using measurement data and density calculations. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes collecting and analyzing measurement data to determine density and identify unknown substances. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.M.2 Explain how matter changes and how physical and chemical changes can be identified using evidence.

SC.7.M.2.1 Determine whether a physical or chemical change has occurred within a system.

Example: A family is camping and places logs on a campfire. As the logs burn, smoke rises into the air, heat and light are released, and ash is left behind.

Student Task(s) –

- Determine whether a physical change or chemical change has occurred.
- Construct a scientific explanation supported by evidence from the scenario.

Benchmark Clarifications:

Clarification 1: Instruction includes changes in state, size, texture, shape, or density as signs of physical change.

Clarification 2: Instruction includes gas production, precipitate formation, color change, odor change, or energy change as evidence of chemical change.

Clarification 3: Instruction includes that a physical change does not produce a new substance, while a chemical change results in the formation of a new substance.

Clarification 4: Instruction includes analyzing observations and data to determine whether a physical or chemical change has occurred.

Clarification 5: Instruction includes conducting investigations and collecting evidence to determine whether a physical or chemical change has occurred. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.M.3 Classify matter and explain atomic structure based on composition, properties, and particle organization.

SC.7.M.3.1 Differentiate between mixtures and pure substances.

Example: Elizabeth finds two containers in her kitchen. One container holds trail mix made of peanuts, raisins, and pretzels. The other container holds table salt. Elizabeth notices that she can easily separate the peanuts, raisins, and pretzels from the trail mix, but she cannot separate the salt into different materials by hand.

Student Task(s) –

- Determine whether each material is a mixture or a pure substance.
- Explain how you know.
- Describe how the components could be separated.

Benchmark Clarifications:

Clarification 1: Instruction includes that mixtures may contain components in different states of matter and do not have fixed proportions.

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Clarification 2: Instruction includes that mixtures contain components that are not chemically combined and can be separated by physical means, while pure substances have a definite composition.

Clarification 3: Instruction includes that elements and compounds are examples of pure substances.

Clarification 4: Instruction includes developing and using models to compare the composition and structure of mixtures and pure substances. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.M.3.2 Distinguish between homogeneous and heterogeneous mixtures.

Example: Layla helps prepare dinner. She shakes a bottle of Italian salad dressing before pouring it onto a salad. At first, the dressing looks mixed together, but after sitting at the table for several minutes, she notices that the oil and vinegar separate into different layers. She also pours herself a glass of fruit punch and her sister a glass of milk. The fruit punch and milk look the same throughout the entire glass, and she cannot see any of the ingredients separately.

Student Task(s) –

- Determine which mixture is homogeneous and which is heterogeneous.
- Determine which mixture is a solution and which is a suspension.
- Use evidence, such as observations or a particle diagram, to explain how you know.

Benchmark Clarifications:

Clarification 1: Instruction includes that a solution is a homogeneous mixture in which a solute is dissolved in a solvent.

Clarification 2: Instruction includes that suspensions and colloids are types of heterogeneous mixtures .Clarification 3: Instruction includes developing and using diagrams or models to distinguish homogeneous and heterogeneous mixtures based on the distribution of their components. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Proposed DRAFT Standards

SC.7.M.3.3 Explain how the atomic number identifies an element and how the numbers of protons and neutrons relate to atomic mass.

Example: Addison, a seventh-grade student, examines models of elements commonly found in the human body, such as hydrogen, carbon, oxygen, and calcium, and compares their atomic numbers and atomic masses.

Student Task(s) –

- Identify the number of protons in each atom.
- Use the atomic number to identify the element.
- Determine the combined number of protons and neutrons represented in each atom.
- Explain how the atomic number identifies an element and how protons and neutrons relate to atomic mass.

Benchmark Clarifications:

Clarification 1: Instruction includes that elements differ by their number of protons and that atomic number equals the number of protons in an element.

Clarification 2: Instruction includes that atomic mass is related to the combined number of protons and neutrons in an atom.

Clarification 3: Instruction includes that the appropriate unit of measurement for the mass of atoms is the atomic mass unit (AMU).

Clarification 4: Instruction includes examining how scientific understanding of atomic structure, including the refinement of atomic theory, developed from evidence over time. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Proposed DRAFT Standards

SC.7.M.3.4 Describe how electrons are organized within an atom based on energy levels and identify valence electrons.

Example: Students examine electron models of several elements and compare how the models represent energy levels and valence electrons.

Student Task(s) –

- Identify the valence electrons represented in each model.
- Compare electron arrangements among different elements.
- Use evidence from the models to explain observed patterns in valence electrons among different elements.
- Use evidence from atomic models and periodic patterns to explain how discoveries about electron arrangement helped scientists understand the organization of the periodic table.

Benchmark Clarifications:

Clarification 1: Instruction includes that electrons occupy energy levels surrounding the nucleus.

Clarification 2: Instruction includes identifying the number of electrons in an atom's outermost energy level as its number of valence electrons.

Clarification 3: Instruction includes recognizing patterns in the number of valence electrons among elements.

Clarification 4: Instruction includes the strengths and limitations of electron models.

Clarification 5: Instruction includes using models of atoms to represent the arrangement of electrons in energy levels and identifying valence electrons. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Proposed DRAFT Standards

Grade 8

SC.8.M.1 Explain how elements are organized and how their structure relates to properties.

SC.8.M.1.1 Explain how elements are organized based on atomic structure.

Example: Students examine patterns in a partially completed periodic table similar to those used by Dmitri Mendeleev. Using information about atomic number, energy levels, valence electrons, and properties, students identify patterns, predict missing information for selected elements, and compare their predictions to a modern periodic table.

Student Task(s) –

- Identify patterns among atomic number, energy levels, valence electrons, and properties.
- Use evidence to predict characteristics of a missing element.
- Compare predictions with information from the modern periodic table.
- Explain how pattern recognition helped scientists develop the periodic table.

Benchmark Clarifications:

Clarification 1: Instruction includes that elements in the periodic table are arranged by atomic number.

Clarification 2: Instruction includes that elements are organized in vertical groups based on their number of valence electrons and similarities in their properties.

Clarification 3: Instruction includes that elements are organized in horizontal periods based on their number of electron energy levels.

Clarification 4: Instruction includes identifying patterns among atomic number, energy levels, and valence electrons that explain the organization of the periodic table.

Clarification 5: Instruction includes using models of atoms and the periodic table to identify relationships among atomic structure, element organization, and properties. Refer

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to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes examining how scientists, including Dmitri Mendeleev, used observed patterns in element properties to develop and refine the periodic table. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.M.1.2 Distinguish metals, nonmetals, and metalloids based on atomic structure.

Example: Tyler examines a selection of elements from different locations on the periodic table and uses provided information about their physical properties. He compares the properties and periodic table locations of the elements and uses atomic models to identify patterns that distinguish metals, nonmetals, and metalloids.

Student Task(s) –

- Use the periodic table to identify patterns in the locations of the three categories.
- Use atomic models to identify patterns in atomic structure associated with the categories.
- Explain how evidence from the properties, periodic table, and models supports each classification.

Benchmark Clarifications:

Clarification 1: Instruction includes that metals are typically conductive, malleable, and ductile.

Clarification 2: Instruction includes that nonmetals are typically poor conductors of heat and electricity.

Clarification 3: Instruction includes that metalloids have properties similar to both metals and nonmetals.

Clarification 4: Instruction includes that an element's position on the periodic table is related to its atomic structure and properties.

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Clarification 5: Instruction includes using models and periodic table representations to identify patterns that distinguish metals, nonmetals, and metalloids. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.M.2 Describe and classify substances based on their physical and chemical properties.

SC.8.M.2.1 Examine acidity using the pH scale.

Example: Students test lemon juice, water, baking soda solution, and liquid dish soap using pH indicators. They compare pH values and identify patterns among acidic, neutral, and basic substances.

Student Task(s) –

- Record the pH value for each substance.
- Compare recorded values for acidity versus basicity.
- Use pH data to classify substances.

Benchmark Clarifications:

Clarification 1: Instruction includes that within the pH range of acids the lower the pH value, the more acidic the substance.

Clarification 2: Instruction includes that within the pH range of bases the higher the pH value, the more basic (alkaline) the substance.

Clarification 3: Instruction includes the use of pH indicators to determine the relative acidity or basicity of substances.

Clarification 4: Instruction includes analyzing numerical patterns and relationships on the pH scale to compare the relative acidity or basicity. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.M.2.2 Describe the physical and chemical properties of acids.

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Example: During a science lab, Connor is given a sample of lemon juice. He observes that it mixes easily with water. He recognizes that lemon juice is commonly described as having a sour taste. When he places a small piece of metal into the lemon juice, bubbles begin to form.

Student Task(s) –

- Use an acid-base indicator to test lemon juice and interpret the result.
- Identify two physical properties and one chemical property of lemon juice.
- Use evidence to explain that a chemical reaction occurred.
- Based on the observations, explain why lemon juice is classified as an acid.

Benchmark Clarifications:

Clarification 1: Instruction includes that acids have physical properties such as a sour taste, solubility in water, or conductivity of their solutions.

Clarification 2: Instruction includes that acids have chemical properties such as a pH less than 7 on the pH scale, reacting with metals, and causing corrosion, tissue damage, or burns.

Clarification 3: Instruction includes recognizing that many acids are compounds based on their characteristic properties.

Clarification 4: Instruction includes collecting and interpreting indicator data to identify and describe the properties of acids. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.M.2.3 Describe the physical and chemical properties of bases.

Example: During a science lab, Lily is given a sample of a household cleaning solution. She observes that the solution feels slippery when handled safely with gloves, mixing easily with water. A few drops of the solution are added to red litmus paper, the paper turns blue.

Student Task(s) –

- Identify two physical properties and one chemical property of the cleaning solution.
- Based on the observations, explain why the solution is classified as a base.

Benchmark Clarifications:

Clarification 1: Instruction includes that bases have physical properties such as a bitter taste, being slippery to the touch, and conductivity of their solutions.

Clarification 2: Instruction includes that bases have chemical properties such as pH greater than 7 on the pH scale, reacting with metals and causing tissue damage or burns.

Clarification 3: Instruction includes recognizing that many bases are compounds based on their characteristic properties.

Clarification 4: Instruction includes collecting and interpreting observational and indicator data to identify and describe the properties of bases. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.M.3 Explain how chemical reactions transform substances and conserve matter.

SC.8.M.3.1 Explain that chemical reactions yield new substances.

Example: After leaving her bicycle outside for several weeks, Abigail notices that the shiny metal chain is now covered with a reddish-brown coating. The chain looks different and feels rougher than before.

Student Task(s) –

- Identify the reactants and products of the chemical reaction.
- Construct a scientific explanation supported by evidence showing that a new substance was formed.

Benchmark Clarifications:

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Clarification 1: Instruction includes that reactants are the substances present before a chemical reaction occurs.

Clarification 2: Instruction includes that products are the substances formed by a chemical reaction.

Clarification 3: Instruction includes that the chemical composition of the products differs from the chemical composition of the reactants.

Clarification 4: Instruction excludes writing or balancing chemical equations.

Clarification 5: Instruction includes safely collecting and analyzing observational evidence to support claims that a chemical reaction has produced new substances. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.M.3.2 Identify the signs of chemical reactions.

Example: Brian investigates several chemical reactions using specific substances. He combines vinegar and baking soda and observes bubbles and a change in temperature. He combines calcium chloride and sodium carbonate solutions and observes the formation of a cloudy solid. In another investigation, he places steel wool in contact with oxygen and observes a gradual color change as the steel wool reacts. He records his observations before, during and after each investigation and organizes the evidence to identify patterns in the indicators of chemical reactions.

Student Task(s) –

- Record the observable changes for each investigation.
- Identify the indicator or indicators of a chemical reaction in each investigation.
- Use evidence from multiple indicators to justify whether a chemical reaction occurred.

Benchmark Clarifications:

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Clarification 1: Instruction includes indicators of chemical reactions: gas production, precipitate formation, color change, energy change, or odor change.

Clarification 2: Instruction includes that the presence of multiple indicators increases confidence that a chemical reaction has occurred.

Clarification 3: Instruction excludes writing and balancing chemical equations.

Clarification 4: Instruction includes safely collecting and analyzing observational evidence to identify patterns across multiple indicators and determine whether a chemical reaction has occurred. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.M.3.3 Model how matter is conserved within a chemical reaction system.

Example: Emerson investigates the reaction between vinegar and baking soda in a sealed container. He measures the mass of the sealed system before and after the reaction and observes gas production during the reaction. He then uses particle models to compare the substances before and after the reaction and identify how atoms are rearranged.

Student Task(s) –

- Create and use particle models to identify how atoms are rearranged during the reaction.
- Compare the total mass before and after the reaction.
- Use the models and mass data to explain how matter is conserved within the chemical reaction system.
- Evaluate one strength and one limitation of particle models.

Benchmark Clarifications:

Clarification 1: Instruction includes that atoms rearrange during chemical reactions but are not created or destroyed, resulting in the same number of atoms of each element before and after the reaction.

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Clarification 2: Instruction includes that the total mass of the reactants equals the total mass of the products in a chemical reaction.

Clarification 3: Instruction is limited to recognizing that chemical reactions follow the Law of Conservation of Mass and interpreting provided, balanced chemical equations as a model.

Clarification 4: Instruction excludes students independently writing and balancing chemical equations.

Clarification 5: Instruction includes using mass data to explain how matter is conserved during a chemical reaction. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes developing and using models to represent the rearrangement of atoms and conservation of matter during chemical reactions. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 7: Instruction includes examining how scientists, including Antoine Lavoisier, used careful measurement and experimental evidence to establish the Law of Conservation of Mass. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.M.3.4 Explain how compounds can form through chemical reactions.

Example: Students examine particle models of two elements before and after a chemical reaction that forms a compound, such as water or table salt. They compare the properties of the elements and the compound and use the models to explain how atoms are rearranged to form a substance with different properties.

Student Task(s) –

- Use a particle model to identify the elements present before the reaction and the compound formed after the reaction.
- Compare the properties of the elements with those of the resulting compound.

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- Use evidence from the model to explain how atoms combine and rearrange to form a new substance.
- Use the model to predict how changing one reactant would affect the compound formed.
- Evaluate one strength and one limitation of the particle model in representing the reaction.

Benchmark Clarifications:

Clarification 1: Instruction includes that compounds form when two or more elements combine chemically.

Clarification 2: Instruction includes that the properties of a compound differ from the properties of the elements from which it formed.

Clarification 3: Instruction is limited to the conceptual recognition of compounds and excludes memorization of specific compounds or chemical formulas.

Clarification 4: Instruction includes developing and using models to explain how elements combine during chemical reactions to form compounds with new properties. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.M.4 Explain how chemical reactions involve energy transfer and how matter forms compounds essential to life.

SC.8.M.4.1 Explain that chemical reactions involve energy transfer.

Example: Students investigate two chemical reactions. In one investigation, they combine vinegar and baking soda in a sealed container and record the temperature before and after the reaction. In another, they combine calcium chloride and water and record the temperature before and after mixing. Students compare the temperature changes and use evidence to determine whether energy was absorbed or released in each investigation.

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Student Task(s) –

- Determine whether energy was absorbed or released during each reaction.
- Explain how the temperature evidence supports the conclusion about energy transfer.

Benchmark Clarifications:

Clarification 1: Instruction includes that some chemical reactions release energy (exothermic).

Clarification 2: Instruction includes that some chemical reactions absorb energy (endothermic).

Clarification 3: Instruction includes using evidence of energy transfer, along with other observations, such as gas production or color change, to support a determination that a chemical reaction has occurred.

Clarification 4: Instruction includes that chemical reaction systems involve both matter conservation and energy transfer.

Clarification 5: Instruction includes interpreting temperature change to determine whether energy is absorbed or released during a chemical reaction. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.M.4.2 Explain how macromolecules are compounds essential to life.

Example: Students examine models of carbohydrates, proteins, lipids and nucleic acids. They compare the structures represented in the models and examine information about the functions of each type of macromolecule in living organisms. Students use models and information to identify patterns between structural features and the functions of the macromolecules.

Student Task(s) –

- Compare structural features shown in each macromolecule model.
- Describe the function of each type of macromolecule in living organisms.

- Use the models to explain how differences in structure relate to differences in function.
- Explain why the elements that make up macromolecules are important to the structure of compounds essential to life.

Benchmark Clarifications:

Clarification 1: Instruction includes carbohydrates, proteins, lipids, and nucleic acids.

Clarification 2: Instruction includes that the structure of a macromolecule relates to its function.

Clarification 3: Instruction includes elements such as carbon, hydrogen, oxygen, nitrogen, and phosphorus, that combine to form compounds essential to life.

Clarification 4: Instruction excludes memorization of specific chemical formulas or examples of macromolecules.

Clarification 5: Instruction includes using models to explain how macromolecule structure relates to function. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

The Science of Force and Motion

How forces act on objects, how motion is described and measured, and how forces are represented and combined.

Grade 6

SC.6.FM.1 Explain how gravitational forces act between objects and how mass and distance influence the strength of these forces.

SC.6.FM.1.1 Recognize that every object with mass exerts gravitational force on every other object with mass.

Benchmark Clarifications:

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Clarification 1: Instruction includes that all objects with mass exert gravitational forces on one another.

Clarification 2: Instruction excludes mathematics calculations.

Clarification 3: Instruction includes identifying objects as components of a gravitational system and analyzing the gravitational interactions among those components.

Clarification 4: Instruction includes developing and using conceptual models to represent gravitational interactions among objects within a system and evaluating strengths and limitations of those models. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.FM.1.2 Describe the relationship between mass, distance, and gravitational force.

Example: Students examine models and data showing gravitational interaction between Earth and the Moon and between Earth and an orbiting satellite. Students compare situations in which the mass of an object changes while distance remains constant and situations in which distance changes while mass remains constant to identify patterns in gravitational force.

Student Task(s) –

- Compare how gravitational force changes when the mass of an object increases while distance remains constant.
- Compare how gravitational force changes when the distance between two objects increases while mass remains constant.
- Use the data and models to identify patterns relating mass, distance, and gravitational force.
- Explain how changes in mass affect gravitational interactions.
- Explain how changes in distance affect gravitational interactions.
- Develop and use a model to explain the relationship among mass, distance, and gravitational force within a gravitational system.

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Benchmark Clarifications:

Clarification 1: Instruction includes that gravitational force increases as mass increases.

Clarification 2: Instruction includes that gravitational force decreases as distance between objects increases.

Clarification 3: Instruction is limited to a conceptual understanding of Isaac Newton's Law of Universal Gravitation and excludes mathematical calculations.

Clarification 4: Instruction includes analyzing patterns in interactions between objects within a gravitational system;identifying system components, boundaries, and interactions; and predicting how changes within the system affect gravitational forces.

Clarification 5: Instruction includes identifying patterns in relationships among mass, distance, and gravitational force. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes using models to analyze gravitational interactions among components within a system and identify how changes in mass or distance affect the interaction. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 7: Instruction includes examining how Newton's Law of Universal Gravitation contributed to scientific understanding of gravitational interactions. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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SC.6.FM.2 Recognize different types of forces and how they act on objects.

SC.6.FM.2.1 Recognize the types of contact and noncontact forces.

Example: Students examine several real-world scenarios. In one scenario, a student pushes a loaded shopping cart across a grocery store floor. In another, a book rests on a classroom desk. In a third, a parachutist falls through the air. In a fourth, a magnet attracts a paper clip without touching it.

Student Task(s) –

- Identify the forces acting on each object and classify each as contact or noncontact.
- Use force diagrams or other models to represent the forces in selected scenarios.

Benchmark Clarifications:

Clarification 1: Instruction includes contact forces: normal, friction, air resistance, and applied.

Clarification 2: Instruction includes noncontact forces: gravitational, magnetic, and electrical.

Clarification 3: Instruction includes identifying forces in real-world scenarios.

Clarification 4: Instruction includes identifying objects as system components and forces as interactions among those components.

Clarification 5: Instruction includes using diagrams or models to identify and represent contact and noncontact forces in real-world scenarios. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes conducting investigations to identify and compare contact and noncontact forces acting on objects. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.6.FM.3 Explain how mass and weight differ and how gravity influences weight.

SC.6.FM.3.1 Distinguish between mass and weight.

Example: Students compare data showing the mass and weight of an astronaut on Earth and on the Moon. Students use the data and a model to distinguish mass from weight and explain how gravitational force affects weight.

Student Task(s) –

- Compare the astronaut's mass on Earth and on the Moon.
- Compare the astronaut's weight on Earth and on the Moon.
- Explain why the astronaut's mass remains constant.
- Explain why the astronaut's weight changes when the gravitational force changes.
- Use a model to represent the relationship among mass, weight, and gravitational force using appropriate units of measure.

Benchmark Clarifications:

Clarification 1: Instruction includes that mass remains consistent regardless of location.

Clarification 2: Instruction includes weight changes depending on the gravitational force and excludes calculating weight using acceleration due to gravity.

Clarification 3: Instruction includes that mass is measured in units such as grams or kilograms, and weight is measured in Newtons (N).

Clarification 4: Instruction includes analyzing mass and weight as properties within gravitational systems and explaining how changes in gravitational conditions affect system behavior.

Clarification 5: Instruction includes using measurements and numerical comparisons to analyze differences between mass and weight under different gravitational conditions. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes using models to represent relationships among mass, weight, and gravitational force. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Grade 7

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Proposed DRAFT Standards

SC.7.FM.1 Explain how motion is described and measured using speed and distance over time.

SC.7.FM.1.1 Describe speed as the distance an object travels per unit of time.

Example: Students compare the motion of three objects during a school STEM investigation. A toy car travels 12 meters in 6 seconds, a student walks 20 meters in 10 seconds, and a scooter travels 30 meters in 5 seconds.

Student Task(s) –

- Identify the distance traveled and time for each object.
- Compare the motion of the toy car and the student.
- Identify which object travels the greatest distance in the same amount of time.
- Explain how distance and time are related to speed.
- Use proportional reasoning to predict how far an object would travel if its time or distance were changed proportionally.

Benchmark Clarifications:

Clarification 1: Instruction includes speed as distance divided by time using meters (m) and seconds (s) and excludes memorization of the speed formula.

Clarification 2: Instruction includes qualitative and quantitative descriptions of motion.

Clarification 3: Instruction includes identifying measurable components and relationships within a motion system, including distance, time, and speed.

Clarification 4: Instruction includes using proportional reasoning to interpret relationships among distance, time, and speed. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes collecting and analyzing motion data from investigations to identify relationships among distance, time, and speed. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Proposed DRAFT Standards

SC.7. FM.1.2 Calculate speed, distance, or time using the relationship among them.

Example: Students measure the time required for several objects to travel a known distance along a school track.

Object	Distance	Measured Time
Soccer ball	20 m	8 s
Student runner	40 m	7 s
Remote-controlled car	30 m	5 s

Students use the relationship among distance, time, and speed to calculate the speed of each object and compare their results.

Student Task(s) –

- Calculate the speed of each object using its measured distance and time.
- Compare the calculated speeds.
- Determine which object traveled at the greatest speed.
- Use the relationship among speed, distance, and time to determine an unknown distance or time in a related scenario.

Benchmark Clarifications:

Clarification 1: Instruction includes speed as distance divided by time using meters (m) and seconds (s) and excludes memorization of the speed formula.

Clarification 2: Instruction includes using measured data to calculate speed, distance, or time. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 3: Instruction includes interpreting measurements collected from investigations of moving systems and using evidence to calculate speed, distance, and time relationships. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Proposed DRAFT Standards

SC.7.FM.2 Explain how motion depends on position and direction relative to a reference point.

SC.7.FM.2.1 Describe motion as a change in position relative to a reference point over time.

Example: Students examine a school bus traveling along a road. Using the bus stop and a backpack inside the bus as reference points, students describe whether the bus and backpack are moving or at rest relative to each reference point.

Student Task(s) –

- Identify the reference point used to describe the motion of the bus.
- Describe the bus's change in position relative to the bus stop.
- Describe the backpack's position relative to the student sitting beside it.
- Describe how the motion of the backpack changes when the bus stop is used as the reference point instead.
- Use a diagram to represent the position of the bus relative to the bus stop at different times.
- Identify the positive and negative directions relative to the chosen reference point.

Benchmark Clarifications:

Clarification 1: Instruction includes the role of a frame of reference.

Clarification 2: Instruction includes positive and negative directions relative to a reference point.

Clarification 3: Instruction is limited to a conceptual understanding of motion and excludes mathematical calculations.

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Clarification 4: Instruction includes defining system boundaries and reference frames when describing motion and identifying how observations depend on the selected frame of reference.

Clarification 5: Instruction includes using diagrams or representations to model motion relative to a reference point. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.FM.2.2 Recognize that velocity is speed in a specific direction.

Example: During track practice, students observe a runner on a straight school track. The starting line is designated as the reference point, with movement toward the finish line represented as positive and movement toward the starting line represented as negative. Students use a position-time graph showing the runner moving away from and then back toward the starting line to identify the direction of motion during different parts of the run.

Student Task(s) –

- Identify the reference point and the positive direction.
- Identify when the student has a positive velocity.
- Identify when the student has a negative velocity.
- Use the position-time graph to describe when the student is moving toward and away from the starting line.
- Explain how direction distinguishes velocity from speed.

Benchmark Clarifications:

Clarification 1: Instruction includes identifying positive and negative velocities.

Clarification 2: Instruction includes interpreting position-time graphs and excludes calculating velocity from graphs.

Clarification 3: Instruction includes interpreting graphical models to describe direction and motion. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Clarification 4: Instruction includes collecting and interpreting motion data to identify changes in direction and describe velocity within a reference system. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.FM.2.3 Distinguish between speed and velocity.

Example: A delivery drone travels 200 meters east in 20 seconds to deliver a package. It then travels 200 meters west in 20 seconds to return to its starting location. Students compare the speed and velocity of the drone during the two portions of the trip.

Student Task(s) –

- Determine the speed of the drone during each portion of the trip.
- Identify the direction of the drone during each portion of the trip.
- Describe how the drone's speed compares during the two portions.
- Describe how its velocity differs during the two portions.
- Explain why the drone can have the same speed but different velocities.

Benchmark Clarifications:

Clarification 1: Instruction includes that speed describes how fast an object moves and is scalar (does not include direction).

Clarification 2: Instruction includes that velocity describes how fast an object moves and includes a specific direction.

Clarification 3: Instruction includes comparing observations, measurements, and scenarios to distinguish speed from velocity.

Clarification 4: Instruction includes analyzing representations of motion to identify how direction affects velocity. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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SC.7.FM.3 Interpret graphs and data to describe patterns of motion.

SC.7.FM.3.1 Interpret distance-time graphs to describe motion.

Example: Students examine a distance-time graph showing the distance of an elevator from the ground floor over a 40-second period. The elevator travels upward from the ground floor, stops at the third floor for several seconds, then continues upward to the fifth floor. Students use the graph to identify when the elevator is moving and when it is stopped and compare the slopes of the different sections of the graph.

Student Task(s) –

- Identify the sections of the graph where the elevator is moving.
- Identify the section where the elevator is stopped.
- Determine which section represents the faster rate of motion.
- Compare the slopes of two sections and explain what the difference means about the elevator's motion.
- Describe the elevator’s motion over the entire 40-second interval using evidence from the graph.

Benchmark Clarifications:

Clarification 1: Instruction includes interpreting distance-time graphs to identify constant speed and changes in motion.

Clarification 2: Instruction includes identifying slopes representing faster or slower motion.

Clarification 3: Instruction includes analyzing motion as behavior of a system over time and identifying how graphical representations describe changes within the system.

Clarification 4: Instruction includes interpreting graphical models and distance-time graphs to describe motion and compare rates of motion. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes collecting and graphing motion data from investigations to identify patterns of motion and interpret relationships represented in

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distance-time graphs. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.7.FM.4 Explain how motion changes over time.

SC.7. FM.4.1 Recognize that acceleration is the rate of change of velocity.

Example: Students examine the motion of a roller coaster car as it travels through three sections of a ride. In the first section, the car speeds up while moving forward. In the second section, the car slows down as it approaches a curve. In the third section, the car changes direction as it moves through the curve. Students use representations of the car's motion to identify how its velocity changes.

Student Task(s) –

- Identify the section in which the car is speeding up, slowing down, and changing direction.
- Explain why each change represents acceleration.
- Use a model or representation to show how the car's velocity changes in each section.

Benchmark Clarifications:

Clarification 1: Instruction includes speeding up, slowing down, and changing direction.

Clarification 2: Instruction is limited to a conceptual understanding of acceleration and excludes mathematical calculations.

Clarification 3: Instruction includes analyzing how interactions within a motion system result in changes in velocity over time.

Clarification 4: Instruction includes using models or representations to describe changes in motion such as speeding up, slowing down, or changing direction. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Clarification 5: Instruction includes conducting investigations to observe acceleration through speeding up, slowing down, and changing direction and using evidence to describe changes in motion. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Grade 8

SC.8.FM.1 Explain how forces are represented and combined.

SC.8. FM.1.1 Recognize that forces have both magnitude and direction and can be represented as vectors.

Example: During a kayaking trip on a Florida spring, students observe that a kayak changes direction as the paddler pushes against the water. The paddler applies a 40-newton force toward the east with the paddle while the moving water exerts a 15-newton force toward the west on the kayak. Students use arrows to represent each force, with the length of each arrow representing the magnitude and the orientation of each arrow representing the direction of the force.

Student Task(s) –

- Identify the magnitude and direction of each force acting on the kayak.
- Represent the 40-N eastward force with a vector.
- Represent the 15-N westward force with a vector.
- Compare the magnitude and direction of the two forces.
- Explain how the length and orientation of each arrow represent the magnitude and direction of the force.

Benchmark Clarifications:

Clarification 1: Instruction includes magnitude as size and direction as orientation.

Clarification 2: Instruction includes representing vectors with arrows.

Clarification 3: Instruction includes representing interactions among components within a system using vector models to explain and predict system behavior.

Clarification 4: Instruction includes distinguishing between vector and scalar quantities. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes using vector models to represent the magnitude and direction of forces and to analyze force interactions within systems. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8. FM.1.2 Determine net force acting on an object.

Example: During a field-day activity at a Florida middle school, two teams pull on opposite ends of a rope. Team A pulls toward the east with a force of 350 newtons (N), while Team B pulls toward the west with a force of 275 newtons (N). Students represent the forces with vectors and determine the net force acting on the rope system. In a second scenario, Team A and Team B each exert a force of 300 newtons (N) in opposite directions.

Student Task(s) –

- Represent the 350-N eastward and 275-N westward forces using vectors.
- Determine the net force and its direction.
- Determine the net force when equal 300-N forces act in opposite directions.
- Explain what a net force of 0 N means for the motion of an object.
- Compare the two scenarios and explain how the magnitude and direction of the forces determine the net force.

Benchmark Clarifications:

Clarification 1: Instruction includes combining forces in the same or opposite direction.

Clarification 2: Instruction includes determining net force in one dimension.

Clarification 3: Instruction includes that zero (0) net force results in no change in motion.

Clarification 4: Instruction includes identifying all relevant interactions acting on an object within a system and explaining how those interactions combine to produce the net force acting on the system.

Clarification 5: Instruction includes combining force values and analyzing numerical relationships to determine net force in one dimension. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes using diagrams and vector representations to determine net force and analyze relationships between force magnitude and direction. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 7: Instruction includes conducting investigations and analyzing measured force data to determine net force and predict changes in motion. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.FM.2 Explain how forces affect the motion of objects.

SC.8. FM.2.1 Distinguish between balanced and unbalanced forces.

Example: At a Florida Gulf Coast marina, students observe a boat being pulled by two dock workers using ropes. In the first scenario, one worker pulls the boat toward the east with a force of 200 newtons (N), while another pulls toward the west with a force of 200 newtons (N). In the second scenario, the eastward force increases to 300 newtons (N) while the westward force remains 200 newtons (N). Students use force vectors and net-force information to determine whether the forces are balanced or unbalanced and predict how the boat's motion would change.

Student Task(s) –

- Represent the forces acting on the boat using vectors.
- Determine whether the forces are balanced or unbalanced in each scenario.
- Explain what the 0-N net force means for the boat's motion in the first scenario.

- Determine the direction of the net force in the second scenario.
- Predict how the boat's motion would change when the forces become unbalanced.
- Explain why an object can have balanced forces while still moving.

Benchmark Clarifications:

Clarification 1: Instruction includes that balanced forces result in constant motion or rest.

Clarification 2: Instruction includes that unbalanced forces cause change in motion.

Clarification 3: Instruction includes analyzing interactions among system components to explain how balanced and unbalanced forces influence system behavior.

Clarification 4: Instruction includes using diagrams or models to compare balanced and unbalanced forces. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes conducting investigations to compare balanced and unbalanced force conditions and collecting evidence to support conclusions about changes in motion. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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SC.8. FM.2.2

Analyze the relationship between net force and changes in motion.

Example: Students investigate two battery-powered carts moving along a straight track. In one investigation, equal forces act in opposite directions on the cart, producing a net force of 0 N. In a second investigation, the forces acting on the cart are unbalanced, producing a net force in the direction of motion. Students compare the motion of the carts using

observations, measurements, and graphical representations to determine how net force affects motion.

Student Task(s) –

- Determine the net force acting on the cart in each investigation.
- Compare the motion of the cart when the net force is 0 N to its motion when the net force is greater than 0 N.
- Use observations and data to identify patterns between net force and changes in motion.
- Analyze motion data or graphical representations to determine when an object's motion remains constant and when it changes.
- Construct an explanation describing how net force influences changes in an object's motion.
- Develop and use a model to represent the relationship between net force and changes in motion within a system.

Benchmark Clarifications:

Clarification 1: Instruction includes that a net force of 0 N results in no change in an object's motion.

Clarification 2: Instruction includes that a nonzero net force results in a change in an object's motion.

Clarification 3: Instruction includes changes in motion such as starting, stopping, speeding up, slowing down, and changing direction.

Clarification 4: Instruction includes analyzing interactions among system components to explain how forces combine to produce a net force and influence system behavior.

Clarification 5: Instruction includes interpreting numerical data, tables, graphs, and force representations to identify relationships between net force and changes in motion. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Clarification 6: Instruction includes developing and using force diagrams, vector representations, and motion models to explain relationships between net force and changes in motion. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 7: Instruction includes conducting investigations and collecting evidence to analyze how changes in net force affect motion. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8.FM.3 Apply Newton's Laws to explain and predict motion.

SC.8. FM.3.1 Apply Newton's First Law to predict motion.

Example: Students examine a scenario involving a school bus traveling on a road. The bus is moving at a constant speed when the driver suddenly applies the brakes to stop for a pedestrian crossing. Students observe or examine a model showing that the bus stops while objects inside the bus continue moving forward. They use Newton's First Law and the concept of inertia to explain and predict the motion of the objects.

Student Task(s) –

- Identify the motion of the bus immediately before the driver applies the brakes.
- Predict what will happen to a water bottle sitting on a passenger seat when the bus stops suddenly.
- Explain why the backpack continues moving forward when the bus stops.
- Use Newton's First Law to explain the backpack's resistance to a change in motion.
- Use a model or evidence from the scenario to support the prediction.

Benchmark Clarifications:

Clarification 1: Instruction includes inertia and resistance to change in motion.

Clarification 2: Instruction includes predicting motion in real-world scenarios.

Clarification 3: Instruction includes identifying interacting components within a motion system and analyzing how changes in forces affect system behavior.

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Clarification 4: Instruction includes constructing and evaluating models of interacting systems to explain inertia and predict motion. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes analyzing evidence from investigations and real-world scenarios to predict motion using Newton's First Law. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes examining the historical development of Newton's First Law and its contribution to understanding motion. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8. FM.3.2 Apply Newton’s Second Law of Motion to describe relationships among force, mass, and acceleration.

Example: Case Study - Before a hurricane, a Florida emergency-response team moves boxes of bottled water using a hand truck. Students compare three scenarios. In the first, the team applies a larger force to the same loaded hand truck. In the second, the team applies the same force to a hand truck carrying more boxes. In the third, the team applies the same force to the original load. Students examine provided data showing the resulting acceleration in each scenario and identify patterns in the relationships among force, mass and acceleration.

Trial	Applied Force	Mass of Hand Truck + Load	Acceleration
1	50 N	50 kg	1.0 m/s^2
2	100 N	50 kg	2.0 m/s^2
3	50 N	100 kg	0.5 m/s^2

Student Task(s) –

- Compare the acceleration when a greater force is applied to the same hand truck.
- Compare the acceleration when the mass of the load increases while the applied force remains the same.
- Identify the pattern between force and acceleration.

- Identify the pattern between mass and acceleration.
- Use the data to explain how changing force or mass affects the motion of the hand truck.
- Construct a representation showing the relationship among force, mass, and acceleration.

Benchmark Clarifications:

Clarification 1: Instruction includes that acceleration increases with force and decreases with mass.

Clarification 2: Instruction is limited to a conceptual understanding of the relationships between force, mass, and acceleration.

Clarification 3: Instruction includes analyzing interacting components within a system to explain how changes in force or mass affect acceleration.

Clarification 4: Instruction includes analyzing data and patterns in force, mass, and acceleration relationships to explain motion. Refer to Mathematics Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 5: Instruction includes conducting investigations and analyzing data to identify relationships among force, mass, and acceleration within a system. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes examining the historical development of Newton's Second Law and its contribution to understanding motion. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

SC.8. FM.3.3 Analyze action-reaction force pairs.

Example: An airboat travels across the shallow waters of the Florida Everglades. The airboat's propeller pushes air backward, while the air exerts a force forward on the propeller and airboat. Students use a model to represent the interaction between the propeller and the air and identify the action-reaction force pair.

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Student Task(s) –

- Identify the two objects interacting in the force pair.
- Identify the force exerted by the propeller on the air.
- Identify the reaction force exerted by the air on the propeller and airboat.
- Represent the two forces with arrows showing their equal magnitude and opposite directions.
- Explain why the two forces do not cancel each other even though they are equal and opposite.
- Use the model to explain how the interaction contributes to the airboat's motion.

Benchmark Clarifications:

Clarification 1: Instruction includes a conceptual understanding of Newton's Third Law of Motion.

Clarification 2: Instruction includes equal magnitude and opposite direction forces.

Clarification 3: Instruction includes that action-reaction forces act on different interacting objects.

Clarification 4: Instruction includes defining interacting objects as components of a system and analyzing interactions between those components.

Clarification 5: Instruction includes developing and using models to represent interactions between objects and action-reaction force pairs. Refer to Modeling Skills Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 6: Instruction includes investigating interactions between objects and collecting evidence to identify action-reaction force pairs. Refer to Laboratory Practices Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

Clarification 7: Instruction includes examining the historical development of Newton's Third Law and its contribution to understanding interactions between objects. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Energy, Matter, and Force and Motion Benchmarks.

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Proposed DRAFT Standards

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The Science of Planet Earth

How Earth's systems are structured; how Earth's processes drive plate movement and the formation of rock and soil; and how Earth's systems influence weather and climate.

Grade 6

SC.6.PE.1 Explain how Earth's systems are structured and interact to transfer matter and energy.

SC.6.PE.1.1 Recognize that Earth's systems interact to transfer matter and energy.

Benchmark Clarifications:

Clarification 1: Instruction includes the atmosphere, biosphere, cryosphere, geosphere, and hydrosphere.

Clarification 2: Instruction includes that matter and energy move between Earth's systems, including interactions involving the atmosphere, biosphere, cryosphere, geosphere, and hydrosphere.

Clarification 3: Instruction includes using models to represent interactions among Earth's systems and the transfer of matter and energy among those systems. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.6.PE.1.2 Explain how solar energy moves through Earth's atmosphere and influences Earth systems.

Benchmark Clarifications:

Clarification 1: Instruction includes that solar radiation is the primary source of energy for Earth systems.

Clarification 2: Instruction includes the role of greenhouse gases in the regulation of Earth's temperature.

Clarification 3: Instruction includes identifying patterns in how solar energy is absorbed, reflected, and re-radiated within Earth's systems. Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 4: Instruction includes using models to represent the movement of solar energy through Earth's atmosphere and surface systems. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 5: Instruction includes examining how scientific understanding of solar radiation and the greenhouse effect has developed over time. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.6.PE.1.3 Recognize the natural processes and anthropogenic activities that affect Earth's systems.

Example: Students examine a Florida coastal area affected by a hurricane and by development along the coastline. They examine evidence showing how the hurricane can move sediment and alter the coastline, while construction and removal of vegetation can

change runoff and sediment movement. Students use a model to trace how each change affects interactions among the atmosphere, hydrosphere, geosphere and biosphere.

Student Task(s) –

- Identify which changes result from a natural process and which result from anthropogenic activity.
- Identify the Earth systems directly affected by each change.
- Use the model to trace how a change in one Earth system can affect another.
- Use the evidence to describe a cause-and-effect relationship among the Earth systems.
- Use the model to identify which Earth systems are involved in the scenario and explain why some systems, such as the cryosphere, may have limited influence in certain regional interactions.

Benchmark Clarifications:

Clarification 1: Instruction includes that changes in one Earth system can affect other systems.

Clarification 2: Instruction includes using models to represent interactions among Earth's systems and the effects of natural processes and anthropogenic activities. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 3: Instruction includes analyzing evidence to identify cause-and-effect relationships among Earth's systems. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.6.PE.2 Describe the structure and composition of Earth's major systems and subsystems.

SC.6.PE.2.1 Describe the structure and composition of Earth's interior.

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Example: Case Study - Students examine a scaled cross-section of Earth showing the crust, mantle, and core and identify the lithosphere and asthenosphere. The model includes the depth and thickness of each layer. Students use the scale and provided measurements to compare the thicknesses of Earth's layers and examine data showing how temperature and density change with depth. They use the model and data to describe relationships among depth, temperature, density and Earth's interior layers.

Depth below Earth's surface (km)	Temperature (°C)	Density (g/cm^3)
0	15	2.7
35	700	3.3
700	1,900	4.5
2,900	3,700	5.5
5,100	5,000	12.0

Student Task(s) –

- Identify the pattern in temperature as depth increases.
- Identify the pattern in density as depth increases.
- Compare the changes in temperature and density across depths.
- Connect those patterns to the Earth's interior model.

Benchmark Clarifications:

Clarification 1: Instruction includes composition layers: crust, mantle and core.

Clarification 2: Instruction includes physical layers such as the lithosphere and asthenosphere.

Clarification 3: Instruction includes that density, temperature, and composition change with depth.

Clarification 4: Instruction includes how differences in density and state of matter influence the behavior of Earth's layers.

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Clarification 5: Instruction includes using models to represent Earth's compositional and physical layers and their relationships. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 6: Instruction includes examining how scientific understanding of Earth's internal structure has developed from indirect evidence over time. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.6.PE.2.2 Describe how Earth's atmosphere is structured and functions.

Example: Students examine a model of Earth's atmosphere in relation to the development of a Florida afternoon thunderstorm. The model identifies the troposphere, stratosphere, mesosphere, thermosphere and exosphere. Students examine information about how the atmosphere's layers contribute to weather, protection from ultraviolet radiation, and temperature regulation. They also consider how Earth's gravity helps keep the atmosphere surrounding Earth.

Student Task(s) –

- Identify the five layers of Earth's atmosphere on the model.
- Identify the layer in which the Florida thunderstorm develops.
- Describe how the atmosphere contributes to temperature regulation and helps protect Earth from ultraviolet radiation.
- Explain how gravity helps retain Earth's atmosphere.
- Use the model to explain how the structure of Earth's atmosphere relates to its functions.

Benchmark Clarifications:

Clarification 1: Instruction includes atmospheric layers: troposphere, stratosphere, mesosphere, thermosphere, and exosphere.

Clarification 2: Instruction includes functions of the atmosphere: weather, ultraviolet radiation (UV) protection, and temperature regulation.

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Clarification 3: Instruction includes that gravity retains the atmosphere.

Clarification 4: Instruction includes using models to represent atmospheric layers and explain their functions. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Grade 7

SC.7.PE.1 Explain how internal Earth processes drive plate movement and shape Earth's structure.

SC.7.PE.1.1 Describe how heat from Earth's interior drives convection.

Example: Students investigate convection using a transparent container of heated water with small pieces of material suspended in the water to make movement visible. They observe that heated material moves upward and cooler material moves downward. Students then examine a model of Earth's interior and use the investigation evidence to explain how heat from Earth's interior can drive convection within Earth.

Student Task(s) –

- Record observations of the movement of material in the investigation.
- Describe what happens to the material as it is heated and cooled.
- Use the investigation evidence to explain why warmer material moves upward and cooler material moves downward.
- Use a model to represent convection within Earth's interior.
- Explain how heat from Earth's interior drives convection.

Benchmark Clarifications:

Clarification 1: Instruction includes that convection within Earth's mantle drives plate movement and contributes to the recycling of crustal materials.

Clarification 2: Instruction includes using models and evidence from investigations to explain convection processes. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 3: Instruction includes collecting and analyzing evidence from investigations to explain convection processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.PE.1.2 Explain how plate tectonics shape Earth’s surface.

Example: Students examine a map and model showing the Pacific Plate and neighboring tectonic plates. They investigate examples of convergent, divergent, and transform boundaries and examine how the relative motion of plates produces different changes at Earth's surface. Students use the model to connect plate motion at each type of boundary to features or processes such as mountain building, seafloor spreading, and earthquakes.

Student Task(s) –

- Identify the type of plate boundary represented in each model.
- Describe how the plates move relative to one another at each boundary.
- Use the model to explain how convergent plate motion can contribute to mountain building and divergent plate motion can produce seafloor spreading.
- Explain how transform plate motion can produce earthquakes.
- Use evidence from the models to explain how plate tectonics shape Earth's surface.

Benchmark Clarifications:

Clarification 1: Instruction includes continental versus oceanic plates; convergent, divergent, and transform boundaries; and lithospheric plates and motion.

Clarification 2: Instruction includes identifying plates as system components and boundaries as regions of interaction.

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Clarification 3: Instruction includes developing and using models to represent plate motion and interactions at plate boundaries. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 4: Instruction includes examining how scientific understanding of plate tectonics developed from multiple lines of evidence. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.PE.1.3 Analyze the outcomes of plate interactions.

Example: Students examine a model showing interactions between tectonic plates at different types of boundaries. One model shows oceanic crust subducting beneath another plate, another shows two continental plates moving toward each other and forming mountains, and a third model shows plates moving past one another. Students examine evidence associated with each interaction and use the models to identify the resulting geologic processes and features.

Student Task(s) –

- Identify the type of plate interaction represented in each model.
- Explain how subduction can result from differences in plate density.
- Identify which interaction can result in mountain building.
- Identify which interactions can produce volcanism and earthquakes.
- Use the models and evidence to explain how the movement and interaction of plates produce specific geologic processes or features.

Benchmark Clarifications:

Clarification 1: Instruction includes subduction, mountain building, volcanism, and earthquakes.

Clarification 2: Instruction includes that differences in density influence plate movement and interactions.

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Clarification 3: Instruction includes using models to explain how different plate interactions result in specific geologic processes and features. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.PE.1.4 Recognize evidence supporting tectonic plates.

Example: Students examine a map of the Atlantic Ocean showing the matching coastlines of South America and Africa, fossil evidence showing the same types of fossils on continents now separated by the Atlantic Ocean, and evidence of seafloor spreading. Students compare the evidence and use multiple lines of evidence to support an explanation that Earth's lithospheric plates have moved over time.

Student Task(s) –

- Identify the evidence shown by the matching continental coastlines.
- Identify what fossil evidence suggests about the past positions of the continents.
- Examine the seafloor-spreading evidence and describe what it indicates about movement of Earth's plates.
- Compare the three lines of evidence.
- Use multiple lines of evidence to support an explanation for tectonic plate movement.

Benchmark Clarifications:

Clarification 1: Instruction includes fossils, continental fit, and seafloor spreading.

Clarification 2: Instruction includes analyzing multiple lines of evidence to support explanations for tectonic plate movement. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

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SC.7.PE.2 Explain how surface processes shape Earth's surface and contribute to soil and rock formation.

SC.7.PE.2.1 Describe how surface processes shape Earth.

Example: Students investigate how moving water affects sediment along a model shoreline. They use a tray containing sand to represent a section of a Florida beach and introduce water at different locations to model wave action. Students observe and record where sediment is weathered, transported, and deposited and compare the shoreline before and after the investigation. They then use their observations and data to explain how surface processes change Earth's surface.

Student Task(s) –

- Identify evidence of weathering, erosion, transport, and deposition in the investigation.
- Record where sediment is removed, transported and deposited.
- Compare the model shoreline before and after the investigation.
- Use the evidence collected to explain how moving water can change Earth's surface.
- Explain how deposition differs from erosion and how transported sediment can eventually contribute to sedimentary rock formation.

Benchmark Clarifications:

Clarification 1: Instruction includes weathering, erosion, transport, and deposition of materials.

Clarification 2: Instruction includes compaction and cementation in sedimentary rock formations.

Clarification 3: Instruction includes collecting and analyzing data from models and investigations to explain weathering, erosion, and deposition processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.PE.2.2 Distinguish between physical and chemical weathering.

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Example: Students examine two weathering scenarios, In the first scenario, tree roots grow into cracks in a rock, causing the rock to fracture into smaller pieces over time. In the second scenario, limestone exposed to acidic rainwater gradually dissolves and develops pits and grooves on its surface. Students compare observations, photographs, models, or investigation data from both scenarios to determine how the weathering processes differ and how each contributes to changes in Earth's surface.

Student Task(s) –

- Identify which scenario represents physical weathering and which represents chemical weathering.
- Use evidence from the scenarios to explain how the rock changes in each case.
- Compare whether the composition of the rock changes during each weathering process.
- Identify the weathering agent responsible for each example.
- Explain how physical and chemical weathering both contribute to shaping Earth's surface.
- Construct a claim supported by evidence distinguishing physical weathering from chemical weathering.

Benchmark Clarifications:

Clarification 1: Instruction includes distinguishing between physical weathering, in which rock is broken into smaller pieces without changing composition, and chemical weathering, in which rock materials are altered through chemical reactions.

Clarification 2: Instruction includes physical weathering: ice wedging, root wedging, animal activity, wind, water, and abrasion.

Clarification 3: Instruction includes chemical weathering: rusting (oxidation), acidification, and dissolution of minerals.

Clarification 4: Instruction includes analyzing evidence from real-world scenarios to distinguish physical and chemical weathering.

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Clarification 5: Instruction includes conducting investigations and using observations, models, or evidence to compare physical and chemical weathering processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.PE.2.3 Explain how soil forms from weathering and biological processes.

Example: Case Study – After several years of weathering in a North Florida forest, exposed rock gradually breaks into smaller particles through the action of water, temperature changes, and plant roots. Fallen leaves, dead plants, animal remains, and a decaying log accumulate on the forest floor. Fungi and other decomposers break down the dead organic material, which combines with weathered rock particles, water, and air to form soil. Over time, scientists observe that the combination of weathered rock and decomposed organic matter forms nutrient-rich soil. The developing soil supports plant growth, stores water, and provides a habitat for many organisms.

Student Task(s) –

- Use evidence from the case study to explain how weathering contributes to soil formation.
- Explain how biological processes, including decomposition by fungi and other decomposers, contribute to soil formation.
- Identify the roles of weathered rock, organic matter, water, and air in soil formation.
- Explain how soil formation results from the interaction of weathering and biological processes over time.
- Use evidence from the case study to explain why soil is important for plant growth and as a habitat for living organisms.

Benchmark Clarifications:

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Clarification 1: Instruction includes contributions to soil formation from rock, organic matter, water, and air.

Clarification 2: Instruction includes the importance of soil for supporting plant growth and providing habitats for living organisms.

Clarification 3: Instruction includes using evidence from observations or investigations to explain soil formation processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.PE.3 Explain how rocks form and how Earth's history is interpreted using evidence.

SC.7.PE.3.1 Explain how rocks form through geological processes.

Example: Students are given a rock-cycle model showing processes such as melting, cooling and crystallization, weathering and erosion, deposition, compaction and cementation, heat and pressure, and uplift. Students select one starting rock, such as granite, and use the model to show two different pathways through which matter from that rock could become part of another rock type.

Student Task(s) –

- Use the model to identify the geological process occurring at each step.
- Trace the movement of matter from the starting rock through the model.
- Explain how the geological process can change the rock type while the matter is continuously cycled through Earth's systems.
- Use evidence from the model to explain why rocks do not follow only one pathway through the rock cycle.

Benchmark Clarifications:

Clarification 1: Instruction includes processes that form igneous, sedimentary, and metamorphic rocks.

Clarification 2: Instruction includes the cycling of matter between rock types.

Clarification 3: Instruction includes using models to explain how rocks form and how matter cycles among rock types. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.PE.3.2 Recognize that Earth's history is organized using the geologic time scale.

Example: Students examine photographs, diagrams or samples representing Florida limestone and fossils found in Florida, such as fossilized shells or other marine organisms. They compare a sequence of rock layers and identify the fossils preserved within the layers.

Student Task(s) –

- Identify the evidence in the rock layers and fossils that provide information about Earth's past.
- Use the position of the layers and the fossils found within them to describe what the evidence reveals about the relative history of the rocks.
- Explain why fossils preserved in rock layers provide evidence about organisms and environments that existed in the past.
- Students will analyze rock strata, fossil succession, index fossils, and radiometric dating models to construct evidence-based explanations for Earth's approximately 4 billion-year history and the organization of major events on the geologic time scale.

Benchmark Clarifications:

Clarification 1: Instruction includes fossils and rock layers as evidence of Earth's history and the age of Earth as approximately 4 billion years old using the oldest known fragments on Earth.

Clarification 2: Instruction includes the principles of relative dating: superposition and fossil succession.

Clarification 3: Instruction is limited to a conceptual understanding of the geologic time scale and excludes numerical dating.

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Clarification 4: Instruction includes examining how evidence collected and refined over time contributes to interpretations of Earth's geologic history. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Grade 8

SC.8.PE.1 Analyze how energy moves through Earth's systems and influences weather and climate.

SC.8.PE.1.1 Distinguish between weather and climate.

Example: Students examine a graph showing daily temperatures and rainfall in Tampa, Florida, over a two-week period alongside a graph showing average monthly temperatures and rainfall in Tampa over many years.

Student Task(s) –

- Identify which graph represents weather and which represents climate.
- Use specific evidence from the graphs to explain how the time period represented differs.
- Explain why a particularly hot or rainy week in Tampa represents weather conditions rather than, by itself, evidence of a change in the area's climate.

Benchmark Clarifications:

Clarification 1: Instruction includes that weather describes short-term atmospheric conditions.

Clarification 2: Instruction includes that climate describes long-term patterns of weather.

Clarification 3: Instruction includes analyzing weather and climate data to identify patterns and distinguish between short-term weather conditions and long-term climate trends.

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Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.PE.1.2 Explain how energy is transferred through Earth's systems to influence weather and climate.

Example: On a sunny summer day along the Florida Gulf Coast, land and ocean absorb energy from the Sun. Students examine a model showing how the land and water warm at different rates and how this difference contributes to the movement of air.

Student Task(s) –

- Use the model to identify where radiation, conduction, and convection transfer energy.
- Explain how differences in the heating of land and water cause air to move and contribute to sea-breeze circulation.
- Use the model and provided temperature data to explain how the transfer of energy through the surface, atmosphere and hydrosphere influences local weather.

Benchmark Clarifications:

Clarification 1: Instruction includes energy transfer through radiation, convection, and conduction.

Clarification 2: Instruction includes that energy transferred among Earth's systems, particularly the atmosphere and hydrosphere, drives weather patterns and influences climate.

Clarification 3: Instruction includes feedback mechanisms that may increase or decrease the effects of energy transfer within Earth's systems, including changes in ice and snow cover that affect reflection and absorption of solar energy.

Clarification 4: Instruction includes using models and data to explain how energy is transferred through Earth's systems and influences weather and climate. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

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SC.8.PE.1.3 Model atmospheric processes that influence weather.

Example: A strong weather system is moving toward your area. The local news station has asked your student weather team to create a forecast explaining what weather conditions are expected and why.

Student Task(s) –

- Analyze a weather map that includes air masses, fronts, jet streams, and high- and low-pressure systems.
- Use data from weather tools such as a barometer, anemometer, satellite images, and Doppler radar.
- Create a weather model showing how the atmospheric features interact.
- Explain how air moves from high pressure to low pressure and how that movement affects weather conditions.
- Predict the weather expected over the next 24 to 48 hours and justify your prediction using evidence from the model.

Benchmark Clarifications:

Clarification 1: Instruction includes air masses, fronts, jet streams, and pressure systems.

Clarification 2: Instruction includes that air flows from high to low pressure.

Clarification 3: Instruction includes the use of scientific tools such as barometers, satellites, anemometers, and Doppler radar.

Clarification 4: Instruction includes developing and using models to explain interactions among air masses, fronts, jet streams, and pressure systems. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.PE.1.4 Explain how ocean currents redistribute heat.

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Example: Students examine a map of ocean currents showing the Gulf Stream moving warm water northward from the Gulf of Mexico and western Atlantic Ocean. They compare surface-water temperature data along the current with temperatures in nearby areas outside the current.

Student Task(s) –

- Use the map to identify the direction in which the Gulf Stream moves warm water.
- Use the temperature data to describe evidence that the current transports thermal energy.
- Explain how the movement of warm ocean water can redistribute heat and influence climate patterns in regions along or near the current.
- Use evidence from the map and data to predict how ocean currents may influence regional temperature and climate patterns.

Benchmark Clarifications:

Clarification 1: Instruction includes that ocean currents redistribute thermal energy by moving warm water from equatorial regions toward the poles and cold water from polar regions toward the equator.

Clarification 2: Instruction includes that surface currents are primarily driven by wind, Earth's rotation (Coriolis effect), and the shape of continents.

Clarification 3: Instruction includes that deep ocean currents are driven by differences in water density caused by temperature and salinity.

Clarification 4: Instruction includes thermohaline circulation as a global system that redistributes heat and influences climate patterns.

Clarification 5: Instruction includes using maps and models to explain how ocean currents can redistribute heat. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.PE.1.5 Analyze factors that influence climate patterns.

Example: Students compare climate data for Miami, Florida; Gainesville, Florida; and a location farther inland in northern Florida. They examine maps showing latitude, elevation, proximity to the Gulf of America or Atlantic Ocean, ocean currents, and local topography, along with temperature and precipitation data.

Student Task(s) –

- Analyze the maps and climate data to identify patterns in temperature and precipitation among the locations.
- Use evidence from the maps and data to explain how latitude, elevation, proximity to water, and topography contribute to differences in climate patterns.
- Identify how a windward or leeward location could influence precipitation in an area with significant topographic relief.

Benchmark Clarifications:

Clarification 1: Instruction includes geographical factors: latitude, elevation, proximity to water, and topography.

Clarification 2: Instruction includes that latitude affects solar energy distribution, elevation affects temperature and atmospheric pressure, and proximity to water influences temperature and precipitation patterns.

Clarification 3: Instruction includes windward and leeward effects.

Clarification 4: Instruction includes analyzing climate data using tables, graphs, and quantitative representations to identify patterns in how geographic factors influence climate. Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 5: Instruction includes collecting and interpreting evidence from maps, models, and climate datasets to explain climate patterns. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

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SC.8.PE.2 Analyze how interactions among Earth's systems influence climate patterns and matter cycling.

SC.8.PE.2.1 Analyze how interactions among Earth's systems influence changes in climate patterns over time.

Example: Students examine data and models showing interactions among Earth's systems, including the atmosphere, hydrosphere, geosphere, biosphere and cryosphere in a Florida coastal region. The evidence includes changes in sea-surface temperature, precipitation, coastal vegetation and water levels over time.

Student Task(s) –

- Analyze the data and model to identify interactions among Earth's systems.
- Use evidence to explain how changes in one Earth system can affect other systems.
- Explain how these interactions can contribute to changes in climate patterns over time.
- Identify whether the evidence represents a natural process or an influence resulting from human activity and explain how it may affect the system.

Benchmark Clarifications:

Clarification 1: Instruction includes interactions among Earth's systems, including the atmosphere, hydrosphere, geosphere, biosphere, and cryosphere.

Clarification 2: Instruction includes natural processes, such as erosion and weathering, and anthropogenic influences, such as land-use change and greenhouse gases, on climate patterns.

Clarification 3: Instruction includes feedback mechanisms.

Clarification 4: Instruction includes analyzing data and evidence to explain how interactions among Earth's systems influence climate patterns over time. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.PE.2.2 Recognize how matter cycles through Earth's systems.

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Example: A nature preserve wants to create an educational exhibit showing how water and carbon move through Earth's systems. Your team has been asked to explain how matter cycles through the atmosphere, hydrosphere, geosphere, and biosphere using evidence from scientific data.

Student Task(s) –

- Analyze diagrams, datasets, or investigation results related to the water cycle and carbon cycle.
- Create a model that traces the movement of matter through Earth's systems.
- Include the processes of evaporation, condensation, precipitation, photosynthesis, respiration, and decomposition in your model.
- Explain how matter moves between living organisms, land, water, and the atmosphere.
- Use evidence from the data to support your explanation of how matter cycles through Earth's systems.

Benchmark Clarifications:

Clarification 1: Instruction includes major matter cycles such as the carbon and hydrologic cycles.

Clarification 2: Instruction includes biological processes: photosynthesis, respiration, and decomposition.

Clarification 3: Instruction includes physical processes: evaporation, condensation, and precipitation.

Clarification 4: Instruction includes using models and data to trace the movement of matter through Earth’s systems. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 5: Instruction includes analyzing evidence from investigations and datasets to explain matter cycling processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

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SC.8.PE.3 Explain how scientists study Earth's interior and magnetic field using evidence and models.

SC.8.PE.3.1 Describe how scientists infer Earth's internal structure.

Example: After a recent earthquake, scientists collected seismic data to learn more about Earth's interior. A science museum wants an exhibit explaining how scientists use earthquake evidence to determine what Earth is made of beneath the surface.

Student Task(s) –

- Analyze seismic wave data showing the paths of P-waves and S-waves through Earth.
- Identify how the waves change speed, bend, or stop as they travel through different materials.
- Use the evidence to infer the locations and characteristics of Earth's layers.
- Explain how density, pressure, and temperature change within Earth and how these factors affect wave behavior.
- Create a model or visual explanation showing how seismic evidence helped scientists develop our current understanding of Earth's internal structure.

Benchmark Clarifications:

Clarification 1: Instruction includes seismic waves (P-waves and S-waves).

Clarification 2: Instruction includes how wave behavior changes in different materials.

Clarification 3: Instruction includes indirect evidence: density, pressure, and temperature.

Clarification 4: Instruction includes examining how evidence from seismic waves contributed to scientific understanding of Earth's internal structure. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.PE.3.2 Recognize the role and generation of Earth's magnetic field.

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Example: Students use a model of Earth showing the outer core, magnetic field and magnetosphere and examine a compass-based navigation scenario involving a vessel traveling along the Florida coast.

Student Task(s) –

- Use the model to identify how movement of molten iron in Earth's outer core generates Earth's magnetic field.
- Explain how the magnetic field extends into space to form the magnetosphere and how the magnetosphere helps protect Earth from charged particles from the Sun.
- Explain how a compass uses Earth's magnetic field to indicate direction and support navigation.

Benchmark Clarifications:

Clarification 1: Instruction includes that movement of molten iron in Earth's outer core generates Earth's magnetic field.

Clarification 2: Instruction includes the formation of the magnetosphere.

Clarification 3: Instruction includes that the magnetosphere helps protect Earth from charged particles originating from the Sun.

Clarification 4: Instruction includes navigation using compasses.

Clarification 5: Instruction includes examining how the use of compasses for navigation contributed to understanding Earth's magnetic field. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.PE.4 Analyze how Earth processes create natural hazards and how human activities influence systems and strategies for sustainability.

SC.8.PE.4.1 Analyze how Earth system processes create natural hazards.

Example: Your community is developing an emergency preparedness guide for residents. Community leaders need to know which natural hazards pose the greatest risk and how Earth system processes contribute to these events. Your team has been asked to analyze the data and make recommendations.

Student Task(s) –

- Analyze maps, weather data, and hazard reports related to hurricanes, flooding, drought, wildfires, and coastal erosion.
- Identify a natural hazard affecting the community.
- Explain how interactions among Earth's systems (atmosphere, hydrosphere, geosphere, and biosphere) contribute to the hazard.
- Use maps, models, and data to identify patterns and assess risk.
- Recommend ways the community can prepare for or reduce the impacts of the hazard.

Benchmark Clarifications:

Clarification 1: Instruction includes hurricanes, flooding, drought, wildfires, and coastal erosion.

Clarification 2: Instruction includes interactions among Earth’s systems that contribute to the development of natural hazards.

Clarification 3: Instruction includes analyzing maps, models, and data to identify patterns and assess risks associated with natural hazards. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.PE.4.2 Evaluate anthropogenic impacts on Earth’s systems and strategies for sustainability.

Example: Your city council is concerned about how human activities are affecting the environment. They have asked student environmental teams to evaluate local

environmental issues and recommend the best strategies to create a more sustainable community.

Student Task(s) –

- Analyze data, maps, articles, and other evidence about one human impact on Earth's systems, such as air pollution, water pollution, habitat loss, or land development.
- Explain how the activity impacts the atmosphere, water resources, land surfaces, or biodiversity.
- Evaluate the evidence for the environmental impact.
- Compare at least two possible mitigation or adaptation strategies.
- Recommend the most effective sustainability solution.
- Explain how the proposed strategy helps maintain the long-term stability of Earth's systems.

Benchmark Clarifications:

Clarification 1: Instruction includes impacts on atmospheric conditions, water resources, land surfaces, and biodiversity.

Clarification 2: Instruction includes mitigation and adaptation strategies.

Clarification 3: Instruction includes sustainability as maintaining long-term stability of Earth’s systems.

Clarification 4: Instruction includes evaluating evidence to compare proposed solutions and sustainability strategies. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

DRAFT

The Science of Space

How the Universe is structured and organized; how the Solar System formed, is structured, and moves; and how scientists use evidence, technology, and models to investigate space.

Proposed DRAFT Standards

Grade 6

SC.6.SP.1 Analyze the structure of the universe, the properties and life cycles of stars, and the organization of galaxies using models and scale relationships to interpret patterns and interactions governed by gravity.

SC.6.SP.1.1 Describe the hierarchical organization of the Universe.

Example: Students use a scale model or series of nested representations to show the relationship among Earth, the Solar System, the Milky Way galaxy, and the observable Universe.

Student Task(s) –

- Use the model to identify which structures are contained within other structures.
- Explain how Earth, the Solar System, the Milky Way, and the observable Universe are related.
- Use evidence from the model to explain how gravity contributes to the organization of structures within the Universe.

Benchmark Clarifications:

Clarification 1: Instruction includes that planets, moons, and small bodies orbit a star to form a solar system.

Clarification 2: Instruction includes that gravitational forces organize stars into galaxies and galaxies are part of the observable Universe.

Clarification 3: Instruction includes that gravity plays a central role in organizing structures within the Universe.

Clarification 4: Instruction is limited to the conceptual relationships among planets, moons and small bodies within solar systems, stars within galaxies, and galaxies within the observable Universe and excludes detailed classification of larger-scale cosmic structures. Instruction acknowledges that additional large-scale structures exist but excludes detailed classification of those structures.

Clarification 5: Instruction includes using models to represent relationships among solar systems, galaxies, and the Universe. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

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Clarification 6: Instruction includes examining how scientific understanding of the structure of the Universe has developed through evidence and observations over time. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.6.SP.1.2 Describe how standard units are used to measure distances in the Universe.

Example: Students examine a scale model showing the distances among Earth, the Moon, the Sun, and a nearby star. The representation identifies the Earth-Sun distance in astronomical units (AU) and the distance to the star in light-years.

Student Task(s) –

- Identify the standard unit used to describe each distance and explain what the unit represents.
- Use the scale representation to compare the distances within the Solar System with the distance to a star beyond the Solar System.
- Explain why AU is useful for describing distances within the Solar System while light-years are useful for describing much larger distances beyond the Solar System.
- Explain how a light-year relates to the distance light travels in one year.

Benchmark Clarifications:

Clarification 1: Instruction includes that light travels at a constant speed and that distance can be understood in relation to the time light takes to travel.

Clarification 2: Instruction includes that astronomical units (AU) are used to describe distances within the Solar System and light-years are used to describe distances to stars and other objects beyond the Solar System, based on the distance light travels in one year.

Clarification 3: Instruction is limited to conceptual understanding of relationships among distance, scale, and time; the use of provided measurements and scale factors to construct and interpret scale models; and excludes mathematical calculations to determine astronomical distances.

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Clarification 4: Instruction includes using spatial reasoning and scale relationships to compare distances in the Universe. Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 5: Instruction includes using scale models to represent large-scale distances in the Universe. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 6: Instruction includes recognizing that data supports a scientific understanding of the age of the Universe as approximately 13.8 billion years. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.6.SP.1.3 Distinguish between major types of galaxies.

Example: A space observatory has received new images from a telescope. Scientists need help identifying the types of galaxies shown in the images before they can be added to a galaxy database. Your team has been asked to analyze the evidence and classify each galaxy.

Student Task(s) –

- Use telescope images and observational data to investigate several galaxies.
- Identify each galaxy as spiral, elliptical, or irregular.
- Describe the structure of each galaxy.
- Compare galaxies based on size, shape, star populations, and the amount of gas and dust present.
- Explain how telescopes help scientists observe and study galaxies.
- Use evidence from the images to justify each classification.

Benchmark Clarifications:

Clarification 1: Instruction includes elliptical, irregular, and spiral galaxies.

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Clarification 2: Instruction includes differences in size, structure, star populations, and gas or dust of a galaxy.

Clarification 3: Instruction includes telescopes as tools to observe galaxies.

Clarification 4: Instruction includes using models to compare structural differences among galaxy types. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 5: Instruction includes analyzing observational evidence to distinguish among galaxy types. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.6.SP.1.4 Describe the properties of stars.

Example: Students examine an H-R diagram containing several stars with different temperatures, colors and luminosities. The stars are identified by letters rather than names.

Student Task(s) –

- Use the H-R diagram to compare the temperature, color and luminosity of two stars.
- Identify patterns in the data that show relationships among these properties.
- Use the provided information about stellar mass to describe how mass is related to the other properties represented.
- Explain how observations and graphical models help scientists describe properties of stars.

Benchmark Clarifications:

Clarification 1: Instruction includes the properties of stars including composition (primarily hydrogen and helium), size, temperature, color, luminosity, and that energy is produced through nuclear fusion.

Clarification 2: Instruction includes relationships among mass, size, temperature, color, and luminosity.

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Clarification 3: Instruction includes analyzing data and identifying patterns to interpret relationships among star properties. Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 4: Instruction includes using graphical models such as H-R diagrams to represent relationships among star properties. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.6.SP.1.5 Describe the life cycles of stars.

Example: Students examine a model showing two stellar life-cycle pathways beginning with protostars. One pathway represents a lower-mass star and the other a higher-mass star. The model shows their progression through later stages and possible outcomes.

Student Task(s) –

- Use the model to describe the stages in each star's life cycle.
- Compare the two pathways and explain how stellar mass influences the life cycle and eventual outcome.
- Identify the possible final outcomes represented in the model, including a white dwarf, neutron star or black hole.
- Use evidence from the model to explain why stars of different masses do not all follow the same life cycle.

Benchmark Clarifications:

Clarification 1: Instruction includes the stages of a star’s life cycle, including protostar, main sequence, and subsequent stages that differ based on stellar mass, and that a star’s mass determines its life cycle pathway and outcomes.

Clarification 2: Instruction includes the differences between low-mass and high-mass star life cycles, and their possible outcomes, such as white dwarfs, neutron stars, and black holes.

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Clarification 3: Instruction includes using models to represent stages in the life cycle of stars. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 4: Instruction includes examining how scientific understanding of stellar life cycles has developed through observational evidence over time. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

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Grade 7

SC.7.SP.1 Analyze and explain the formation, structure, and motion of the Solar System, including the role of gravity and energy; and interpret patterns and properties of celestial objects using models and observational data.

SC.7.SP.1.1 Explore scientific models explaining the formation of the Solar System.

Example: Students examine a model showing the formation of the Solar System from a rotating cloud of gas and dust. They analyze observations of the Solar System, including the similar orbital direction of most planets and the concentration of most planetary orbits in a relatively flat plane, as evidence used to support the model.

Student Task(s) –

- Use the model to describe how the Solar System could have developed from a rotating cloud of gas and dust.
- Identify observations represented in the evidence that support the model.
- Explain how scientific models of Solar System formation are based on evidence and can be refined as new evidence becomes available.

Benchmark Clarifications:

Clarification 1: Instruction includes evaluating observational evidence used to support scientific models of Solar System formation and excludes detailed mathematical modeling of planetary formation processes.

Clarification 2: Instruction includes using scientific models to describe how the Solar System could have developed. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 3: Instruction includes analyzing observational evidence used to support Solar System formation. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 4: Instruction includes that scientific models are based on evidence and have developed over time. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.SP.1.2 Recognize the components of the Solar System.

Example: Students examine and use a system model of the Solar System that includes the Sun, planets, moons, dwarf planets, asteroids, and comets.

Student Task(s) –

- Use the model to identify the major components of the Solar System.
- Describe how gravity affects the motion of objects within the system.
- Use the model to explain the relationship between an object and the body it orbits, including a planet orbiting the Sun and a moon orbiting a planet.
- Identify interactions represented in the model that show why the Solar System functions as a system.

Benchmark Clarifications:

Clarification 1: Instruction includes components of the Solar System: Sun, planets, moons, dwarf planets, asteroids, and comets.

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Clarification 2: Instruction includes that gravity holds objects in orbit and orbital motion can be understood as continuous falling toward the object being orbited.

Clarification 3: Instruction includes using system models to represent Solar System components and their interactions. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.SP.1.3 Describe the relative size and distance of Solar System objects.

Example: Students use a scale model of the Solar System that represents the Sun and planets using scaled sizes and positions.

Student Task(s) –

- Use the model to compare the relative sizes of the Sun and planets and the relative distances between the planets and the Sun.
- Explain why a model that accurately represents both relative size and relative distance is difficult to construct at a convenient classroom scale.
- Use spatial reasoning to describe patterns in the sizes and distances of Solar System objects.

Benchmark Clarifications:

Clarification 1: Instruction includes components of the Solar System: Sun, planets, moons, dwarf planets, asteroids, and comets.

Clarification 2: Instruction is limited to conceptual comparisons of relative size and distance and excludes calculations of actual astronomical distances or sizes.

Clarification 3: Instruction includes using spatial reasoning and scale relationships to compare the relative sizes and distances of Solar System objects. Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 4: Instruction includes using scale models to represent relative size and distance within the Solar System. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

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SC.7.SP.1.4 Explain how the Sun produces and transfers energy.

Example: Students examine a cross-sectional model of the Sun showing the core, radiative zone, and convective zone.

Student Task(s) –

- Use the model to identify where nuclear fusion releases energy in the Sun.
- Trace the movement of energy from the core through the Sun using the model.
- Explain how radiation and convection transfer energy through different regions of the Sun.
- Use the model to explain how energy released in the Sun's core eventually reaches the Sun's surface.

Benchmark Clarifications:

Clarification 1: Instruction is limited to a conceptual understanding of nuclear fusion as the process that releases energy in the Sun’s core.

Clarification 2: Instruction includes the transfer of energy by convection and radiation.

Clarification 3: Instruction excludes detailed nuclear reaction equations or calculations.

Clarification 4: Instruction includes using conceptual models to represent energy release in the Sun and energy transfer through convection and radiation. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.SP.1.5 Explain how gravity influences motion in the Solar System.

Example: Students use a model showing two planets with different masses and distances from the Sun. They examine how changing the planet's mass or its distance from the Sun affects the gravitational interaction.

Student Task(s) –

- Use the model to explain how the mass of an object and its distance from another object affect gravitational force.

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- Explain how the Sun's gravitational force and a planet's forward motion work together to produce orbital motion.
- Use the model to predict how increasing the distance between two objects would affect their gravitational interaction.
- Explain why an object in orbit does not simply fall directly into the Sun.

Benchmark Clarifications:

Clarification 1: Instruction includes that gravity depends on mass and distance.

Clarification 2: Instruction includes that gravitational force keeps objects in orbit.

Clarification 3: Instruction includes that orbital motion results from gravity and forward motion.

Clarification 4: Instruction is limited to conceptual relationships among mass, distance, gravitational force, and orbital motion and excludes calculations using the universal law of gravitation.

Clarification 5: Instruction includes using qualitative and proportional reasoning to analyze how changes in mass and distance affect gravitational force. Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 6: Instruction includes using system models to explain orbital motion. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.SP.1.6 Compare properties of inner and outer planets.

Example: A space science club is creating a display comparing planets in our Solar System. Using images and data collected from telescopes and space probes, the students notice that Mercury, Venus, Earth, and Mars differ from Jupiter, Saturn, Uranus, and Neptune in several ways.

Student Task(s) –

- Use a model or data chart to compare the inner and outer planets.

- Explain how they differ in size, composition, atmosphere, temperature, number of moons, and presence of rings.
- Describe how scientific tools, such as telescopes and spacecraft, help scientists observe and monitor these planets.

Benchmark Clarifications:

Clarification 1: Instruction includes the properties of planets: size, composition, atmosphere, temperature, moons (satellites), and planetary rings.

Clarification 2: Instruction includes how scientific tools are used to observe and monitor the Solar System.

Clarification 3: Instruction includes terrestrial and gas/ice giant classifications.

Clarification 4: Instruction excludes detailed study of individual planetary internal structures.

Clarification 5: Instruction includes using system models to compare properties of inner and outer planets. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 6: Instruction includes analyzing observational data to compare planetary properties. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.7.SP.1.7 Describe comets, asteroids, and meteoroids.

Example: While studying objects in the Solar System, students examine images and data from space telescopes. They find several objects traveling through space, including a comet with a glowing tail, rocky asteroids orbiting the Sun, and a meteoroid moving toward Earth.

Student Task(s) –

- Describe the characteristics of comets, asteroids, and meteoroids, including their composition, location, and motion within the Solar System.

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- Explain the differences between a comet, asteroid, meteoroid, meteor, and meteorite using evidence from the observations.

Benchmark Clarifications:

Clarification 1: Instruction includes characteristics of comets, asteroids, and meteoroids, including composition, location, and motion within the Solar System.

Clarification 2: Instruction includes distinguishing among comets, asteroids, meteoroids, meteors, and meteorites.

Clarification 3: Instruction excludes detailed analysis of physical or chemical composition.

SC.7.SP.1.8 Analyze patterns in planetary motion.

Example: A team of student astronomers is analyzing data from the Solar System. They notice that some planets complete an orbit around the Sun much faster than others. Using a data table that includes each planet's distance from the Sun and orbital period, they look for patterns in the motion of the planets.

Student Task(s) –

- Analyze the data to determine the relationship between a planet's distance from the Sun and its orbital period.
- Use proportional reasoning to identify patterns in planetary motion.
- Explain how the data supports Kepler's observation that planets farther from the Sun take longer to complete an orbit.
- Use the pattern to predict the orbital period of a hypothetical planet located farther from the Sun than Neptune.

Benchmark Clarifications:

Clarification 1: Instruction includes the relationship between distance and orbital period.

Clarification 2: Instruction includes analyzing provided data sets.

Clarification 3: Instruction includes a conceptual analysis of patterns consistent with Kepler's laws and excludes mathematical derivations or calculations using Kepler's laws.

Clarification 4: Instruction includes using data analysis and proportional reasoning to identify patterns in planetary motion. Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 5: Instruction includes analyzing data sets to interpret relationships between distance and orbital period. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

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Grade 8

SC.8.SP.1 Analyze and explain how interactions among the Sun, Earth, and Moon produce observable patterns and phenomena including energy distribution, motion, phases, eclipses, and tides.

SC.8.SP.1.1 Describe how solar energy affects Earth.

Example: Students use a model of Earth to compare how sunlight strikes Earth's surface at different latitudes. The model shows that sunlight is more concentrated when it strikes a surface more directly and is more spread out when it strikes at a lower angle.

Student Task(s) –

- Use the model to compare the distribution of solar energy at different latitudes.
- Explain how the angle at which sunlight reaches Earth's surface affects the amount of energy received.
- Use the evidence from the model to explain how unequal solar heating contributes to differences in atmospheric and oceanic processes.

Benchmark Clarifications:

Clarification 1: Instruction includes direct versus indirect sunlight.

Clarification 2: Instruction includes that unequal heating of Earth contributes to atmospheric and oceanic circulation patterns.

Clarification 3: Instruction includes analyzing data and identifying patterns in the distribution of solar energy across Earth. Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 4: Instruction includes using conceptual models to represent the distribution of solar energy across Earth. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.SP.1.2 Differentiate between rotation and revolution of objects in the Solar System.

Example: Students use a model of the Solar System to examine the rotational and orbital motion of the Sun, planets, moons, asteroids, and comets.

Student Task(s) –

- Identify examples of rotation and revolution (orbital motion) among the objects represented in the model.
- Compare the motion of a planet with the motion of a moon, asteroid, and comet.
- Explain how an object's rotation about its axis differs from its revolution around another object.
- Use the model to describe how different Solar System objects can have both rotational and orbital motion.

Benchmark Clarifications:

Clarification 1: Instruction includes rotation and revolution of objects in the Solar System, including the Sun, planets, moons, dwarf planets, asteroids, and comets.

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Clarification 2: Instruction includes using system models to explain rotational and orbital motion. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.SP.1.3 Describe the motion and phases of the Moon.

Example: Students use a model of the Sun, Earth, and Moon to represent the Moon's revolution around Earth while sunlight illuminates the Moon.

Student Task(s) –

- Use the model to describe how the Moon's rotation and revolution differ.
- Move the Moon through different positions around Earth and observe the portion of the Moon illuminated by the Sun from Earth's perspective.
- Use the model to explain how the changing relative positions of the Sun, Earth and Moon produce the observed phases.
- Explain why the Moon's phases are not caused by Earth's shadow.

Benchmark Clarifications:

Clarification 1: Instruction includes the Moon’s rotation and revolution.

Clarification 2: Instruction includes Moon phases as changing visible illumination.

Clarification 3: Instruction includes explaining Moon phases as the result of the changing relative positions of the Sun, Earth, and Moon.

Clarification 4: Instruction excludes explanations based on Earth’s shadow except when distinguishing lunar phases from lunar eclipses.

Clarification 5: Instruction includes using system models to represent the positions of the Sun, Earth, and Moon and explain lunar phases. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.SP.1.4 Analyze solar and lunar eclipses.

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Example: Students use a model of the Sun, Earth, and Moon to represent the alignments that produce solar and lunar eclipses.

Student Task(s) –

- Use the model to identify the relative positions of the Sun, Earth and Moon during a solar eclipse and a lunar eclipse.
- Compare the two alignments and explain how they produce different observable phenomena.
- Examine a provided record of eclipse observations and identify patterns in when eclipses occur.
- Explain why a solar or lunar eclipse does not occur during every new or full Moon.

Benchmark Clarifications:

Clarification 1: Instruction includes conceptual understanding of the alignment and relative positions of the Sun, Earth, and Moon during solar and lunar eclipses.

Clarification 2: Instruction includes the differences between solar and lunar eclipses.

Clarification 3: Instruction excludes detailed orbital mechanics.

Clarification 4: Instruction includes analyzing patterns in the timing and occurrence of eclipses. Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 5: Instruction includes using models to explain alignments of the Sun, Earth, and Moon that result in eclipses. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.SP.1.5 Explain how gravity influences tides.

Example: Students examine a model showing the relative positions of the Earth, Moon, and Sun along with a simplified tide dataset for a coastal location.

Student Task(s) –

- Use the model to explain how the gravitational interactions among the Earth, Moon, and Sun influence ocean tides.
- Use the data to identify patterns associated with high and low tides.
- Compare the positions of the Moon and Sun during spring tides and neap tides and explain how their relative positions affect the tidal pattern.
- Use evidence from the model and data to explain why tidal patterns change over time.

Benchmark Clarifications:

Clarification 1: Instruction includes high and low tides as well as spring and neap tides.

Clarification 2: Instruction excludes detailed mathematical modeling of tidal forces.

Clarification 3: Instruction includes analyzing patterns in the timing and magnitude of tides using data and pattern recognition. Refer to Mathematics Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 4: Instruction includes using system models to explain how gravitational interactions involving the Moon and Sun influence tides. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.SP.2 Analyze and evaluate how scientists use electromagnetic radiation, technology, and models to study space, and explain large-scale phenomena such as universe expansion and space-based effects on Earth.

SC.8.SP.2.1 Recognize how scientists use electromagnetic radiation to study space.

Example: A team of astronomers is studying a distant galaxy. Images taken with a visible-light telescope show bright stars, but another telescope that detects infrared radiation reveals clouds of dust hiding new stars. A third telescope detects X-rays coming from a black hole at the galaxy's center.

Student Task(s) –

- Identify which observations were made using visible light and which were made using nonvisible electromagnetic radiation.
- Explain why scientists use different types of electromagnetic radiation to study space objects.
- Create a model showing where visible light, infrared radiation, and X-rays fit within the electromagnetic spectrum.
- Use observational data to determine what scientists learned about the galaxy from each type of radiation.

Benchmark Clarifications:

Clarification 1: Instruction includes visible and nonvisible forms of electromagnetic radiation used to observe and study objects in space.

Clarification 2: Instruction includes visible light, infrared radiation, ultraviolet radiation, radio waves, X-rays, and gamma rays as examples of electromagnetic radiation used to study space.

Clarification 3: Instruction is limited to recognizing how different forms of electromagnetic radiation provide information about objects in space and excludes mathematical calculations involving wavelength, frequency, or photon energy.

Clarification 4: Instruction includes using models to represent properties and types of electromagnetic radiation. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 5: Instruction includes analyzing observational data used to study space objects through electromagnetic radiation. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.SP.2.2 Describe how technology is used to investigate space.

Example: Scientists are investigating Mars to determine whether it may have supported life in the past. They use images from a satellite orbiting Mars, photographs and rock samples collected by a rover on the surface, and data sent back by a probe studying the planet's atmosphere.

Student Task(s) –

- Identify which data were collected by the satellite, rover, and probe.
- Explain how each type of space-based technology helps scientists learn about Mars.
- Interpret the data to describe what scientists discovered about the planet's surface and atmosphere.
- Determine which technology provided the most useful evidence for answering the investigation question and justify your reasoning.

Benchmark Clarifications:

Clarification 1: Instruction includes telescopes, satellites, probes, and rovers.

Clarification 2: Instruction includes interpreting data collected by space-based technologies. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.SP.2.3 Recognize that the Universe is expanding.

Example: A group of astronomers is comparing images of galaxies at different distances from Earth. They learn that light from the most distant galaxies took billions of years to reach Earth, allowing scientists to observe what those galaxies looked like in the past. They also use models showing galaxies moving farther apart over time.

Student Task(s) –

- Explain how observing distant galaxies allows scientists to study the past.
- Examine a model of galaxies spreading farther apart and describe how it represents an expanding universe.
- Identify evidence that has helped scientists develop the idea that the Universe is expanding.
- Use the model and evidence to explain why scientists conclude that galaxies are moving farther apart over time.

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Benchmark Clarifications:

Clarification 1: Instruction is limited to conceptual analysis of models that represent the expansion of the Universe.

Clarification 2: Instruction includes light-travel time as a way of observing the past.

Clarification 3: Instruction includes using conceptual models to explain the expansion of the Universe. Refer to Modeling Skills Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

Clarification 4: Instruction includes examining how scientific understanding of the expanding Universe has developed through evidence over time. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

SC.8.SP.2.4 Recognize how space-based phenomena affect Earth.

Example: A powerful solar flare erupts from the Sun and sends energy and charged particles toward Earth. Scientists monitor the event and warn that it could temporarily disrupt satellite operations, GPS signals, and radio communications.

Student Task(s) –

- Analyze data showing changes in solar activity and satellite communication signals.
- Describe how the solar flare affected technology on Earth.
- Explain why satellites and communication systems can be impacted by space-based phenomena.
- Use evidence from the data to support the claim that solar activity can affect Earth and human activities.

Benchmark Clarifications:

Clarification 1: Instruction includes solar activity such as solar flares.

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Clarification 2: Instruction includes impacts of space-based phenomena on Earth's technological systems, including satellites, global positioning systems (GPS), and communications.

Clarification 3: Instruction is limited to conceptual understanding of observable effects of space-based phenomena on Earth and Earth's technological systems and excludes detailed models of solar or space-weather processes.

Clarification 4: Instruction includes analyzing data and evidence to explain how space-based phenomena affect Earth. Refer to Laboratory Practices Supporting Mastery of 6-8 Planet Earth and Space Benchmarks.

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The Science of Life

Where life exists, how living systems are organized, how organisms interact, and how biodiversity is classified and sustained.

Grade 6

SC.6.SL.1 Explain how ecosystems are structured and how living and non-living components are organized within systems.

SC.6.SL.1.1 Recognize how ecosystems are organized as systems with increasing levels of complexity from organisms to the biosphere.

Example: Students examine a diagram of a Florida coastal ecosystem that begins with a single bottlenose dolphin, expands to a population of bottlenose dolphins, includes other organisms living in the same coastal area, expands to the coastal ecosystem, then to the Florida coastal biome and finally the biosphere. The diagram also identifies non-living components such as water, sunlight, temperature, and dissolved oxygen at the ecosystem level.

Student Task(s) –

Identify the organism, population, community, ecosystem, biome, and biosphere represented in the diagram.

Explain how each level includes or contains the levels below it.

Distinguish between biotic and abiotic components represented in the ecosystem.

Use the model to explain how biological organization increases in complexity from organism to biosphere.

Benchmark Clarifications:

Clarification 1: Instruction includes levels of biological organization within ecosystems, including organism, population, community, ecosystem, biome, and biosphere.

Clarification 2: Instruction includes living and non-living components of ecosystems.

Clarification 3: Instruction includes using pattern recognition to analyze levels of biological organization. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using structural models to represent hierarchical relationships among levels of biological organization. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.6.SL.1.2 Explain how changes in one part of an ecosystem affect other parts of the system.

Example: Students examine a scenario in which a drought reduces the amount of water available in a Florida freshwater ecosystem.

Student Task(s) –

Identify the abiotic factor that changed.

Use an ecosystem model to trace how the reduction in water affects plants, animals, and other components of the system.

Explain the cause-and-effect relationships among the changes.

Use provided evidence to support an explanation of how a change in one component affects other parts of the ecosystem.

Benchmark Clarifications:

Clarification 1: Instruction includes that living and non-living components of ecosystems are interconnected.

Clarification 2: Instruction includes that changes in biotic and abiotic factors affect populations and influence other parts of the ecosystem.

Clarification 3: Instruction includes using cause-and-effect relationships to analyze ecosystem changes.

Clarification 4: Instruction includes identifying patterns and relationships among components and factors within ecosystem interactions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analyzing data and evidence to explain how changes in ecosystem components affect system interactions. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.SL.2 Explain how organisms are classified and how classification systems are used to determine relationships among organisms.

SC.6.SL.2.1 Recognize that living organisms are classified in a hierarchy according to shared characteristics.

Example: Case Study – A group of Florida animals including a black bear, raccoon, and domestic dog are all classified within the order Carnivora despite differences in appearance and habitat.

Student Task(s) –

Compare the classification levels of the three organisms using a classification chart.

Identify the classification levels the organisms share and the levels at which their classifications become more specific.

Explain how the classification hierarchy organizes organisms into increasingly specific groups based on shared characteristics.

Benchmark Clarifications:

Clarification 1: Instruction includes the levels of biological classification: domain, kingdom, phylum, class, order, family, genus, and species.

Clarification 2: Instruction includes that organisms grouped within the same classification level share characteristics used to define that group.

Clarification 3: Instruction is limited to recognizing how organisms are classified within the hierarchy and excludes identifying or memorizing specific characteristics associated with each classification group.

Clarification 4: Instruction includes identifying patterns in the hierarchical organization of classification systems and using comparative reasoning to determine relationships among organisms. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using classification models to represent hierarchical relationships among organisms. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.6.SL.2.2 Infer the relatedness of two organisms based on shared classification levels or shared characteristics.

Example: A Florida alligator and snapping turtle are both classified as reptiles but differ at several lower classification levels.

Student Task(s) –

Compare the classification levels of the alligator and snapping turtle using a classification chart.

Identify the classification levels they share and the levels at which their classifications differ.

Use the shared classification levels and provided characteristics to infer their relative relatedness.

Support the inference with evidence from the classification information.

Benchmark Clarifications:

Clarification 1: Instruction includes determining relatedness using provided classification levels or shared characteristics.

Clarification 2: Instruction is limited to comparing classification levels or characteristics and excludes identifying or memorizing specific characteristics associated with each classification group.

Clarification 3: Instruction includes identifying patterns in shared classification levels to determine degrees of relatedness among organisms. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as classification charts, Venn diagrams, or branching diagrams to represent relationships among organisms based on shared classification levels. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analyzing data or evidence from scenarios to support explanations of relationships among organisms. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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SC.6.SL.2.3 Distinguish the characteristics of organisms in the three domains: Archaea, Bacteria, and Eukarya.

Example: Students examine a comparison chart containing information about representative organisms from Archaea, Bacteria, and Eukarya.

Student Task(s) –

Compare the characteristics provided for organisms in the three domains.

Identify characteristics shared by organisms in Archaea and Bacteria and characteristics that distinguish them from one another.

Identify characteristics that distinguish Eukarya from the two prokaryotic domains.

Use the evidence in the comparison chart to classify each representative organism within its domain.

Benchmark Clarifications:

Clarification 1: Instruction includes that Archaea are prokaryotic organisms that may be found in a variety of environments, including environments with extreme conditions.

Clarification 2: Instruction includes that Bacteria are prokaryotic organisms found in a wide range of environments and are distinct from Archaea.

Clarification 3: Instruction includes that Eukarya are eukaryotic organisms whose cells contain a nucleus.

Clarification 4: Instruction includes comparing characteristics of organisms in the three domains to identify similarities and differences. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as classification diagrams or comparison charts to distinguish characteristics of organisms in the three domains. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.6.SL.2.4 Distinguish the characteristics of organisms in the four kingdoms of the Domain Eukarya.

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Example: Students examine a comparison chart containing representative organisms from Protista, Fungi, Plantae, and Animalia. The chart provides information about whether each organism is unicellular or multicellular and whether it obtains energy as an autotroph or heterotroph.

Student Task(s) –

Compare the organisms using the characteristics provided in the chart.

Identify patterns in cellular organization and how organisms obtain energy.

Use the evidence to distinguish among the four traditional Eukarya kingdoms.

Explain which characteristics support the classification of each organism.

Benchmark Clarifications:

Clarification 1: Instruction includes the traditional kingdoms commonly used to classify organisms within Domain Eukarya: Protista, Fungi, Plantae, and Animalia.

Clarification 2: Instruction includes distinguishing organisms in the four kingdoms based on cellular organization (unicellular or multicellular) and method of obtaining energy (autotroph or heterotroph).

Clarification 3: Instruction includes identifying patterns in organism characteristics such as cellular organization and method of obtaining energy. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as comparison tables or classification charts to distinguish characteristics of organisms in the four kingdoms. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.6.SL.2.5 Describe how classification systems change over time based on new scientific evidence.

Example: Students compare an early two-kingdom classification system with a later classification system that added additional groups and eventually recognized the three domains.

Student Task(s) –

Compare the two classification systems using a provided diagram or timeline.

Identify what changed between the systems.

Examine the evidence or technology that contributed to the changes.

Describe how the new evidence changed scientists' understanding of how organisms are related and how they should be classified.

Benchmark Clarifications:

Clarification 1: Instruction includes that early classification systems did not include domains and that domains were added as scientific understanding of organisms expanded.

Clarification 2: Instruction includes that classification systems are revised as new scientific evidence and technologies become available.

Clarification 3: Instruction includes using models such as timelines or comparative diagrams to represent changes in classification systems over time. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes describing how new evidence has changed scientific understanding of relationships among organisms. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

SC.6.SL.3 Explain how organisms interact with each other and with their environment to support the flow of energy and cycling of matter in ecosystems.

SC.6.SL.3.1 Recall the role of producers, consumers, and decomposers in the flow of energy and cycling of matter in an ecosystem.

Example: Students examine a food web involving phytoplankton, small fish, larger fish, and decomposers in a coastal ecosystem.

Student Task(s) –

Use the food web to identify the producers, consumers, and decomposers.

Trace how energy is transferred through the feeding relationships.

Explain how decomposers return matter from dead organisms and waste to the environment.

Use the model to distinguish how energy moves through the ecosystem from how matter cycles among organisms and the environment.

Benchmark Clarifications:

Clarification 1: Instruction includes producers, consumers, and decomposers as roles in ecosystems.

Clarification 2: Instruction includes consumer roles within feeding relationships, including primary, secondary, and tertiary consumers.

Clarification 3: Instruction includes that energy is transferred through feeding relationships while matter cycles among organisms and the environment.

Clarification 4: Instruction includes identifying patterns in the flow of energy through trophic levels in ecosystems. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as food chains, food webs, and energy flow diagrams to represent the roles of producers, consumers, and decomposers. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.6.SL.3.2 Analyze interactions among organisms and between abiotic and biotic factors in ecosystems.

Example: A change in the availability of water affects plants in a Pine Rockland ecosystem, which can influence the animals that depend on those plants for food and shelter.

Student Task(s) –

Identify the biotic and abiotic factors involved in the scenario.

Analyze how the change in water availability affects interactions among organisms and between organisms and their environment.

Identify the limiting factor and explain how it can affect population size, growth, or survival.

Use an ecosystem model and provided evidence to support an explanation of the relationships among the affected components.

Benchmark Clarifications:

Clarification 1: Instruction includes biotic interactions including mutualism, commensalism, parasitism, predation, disease, and competition.

Clarification 2: Instruction includes abiotic factors such as water, sunlight, oxygen, temperature, available space, and shelter.

Clarification 3: Instruction includes limiting factors that restrict the size, growth, or survival of a population.

Clarification 4: Instruction includes identifying patterns and trends in ecosystem data to explain changes in population or system conditions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as food webs or ecosystem diagrams to represent interactions among organisms and environmental factors. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analyzing data and evidence to explain interactions among biotic and abiotic components in ecosystems. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Grade 7

SC.7.SL.1 Explain how energy from the Sun and matter move through ecosystems to support living organisms.

SC.7.SL.1.1 Explain how photosynthesis provides a pathway for energy flow from the Sun and matter cycling in ecosystems.

Example: Students examine how seagrass uses sunlight, carbon dioxide, and water to produce food and how the resulting plant matter supports organisms in the coastal food web.

Student Task(s) –

Identify the energy input and matter inputs involved in photosynthesis.

Explain how light energy is transformed into chemical energy stored in food.

Trace how energy moves from the Sun to seagrass and then to consumers.

Explain how matter incorporated into the seagrass becomes available to other organisms through feeding and is eventually returned to the environment.

Benchmark Clarifications:

Clarification 1: Instruction includes that photosynthesis transforms light energy into chemical energy stored in food.

Clarification 2: Instruction includes that producers use photosynthesis to convert light energy into chemical energy and incorporate matter from the environment into food molecules.

Clarification 3: Instruction includes identifying patterns in the flow of energy through ecosystems. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using conceptual models, diagrams, and flow models to represent the transformation of light energy into chemical energy, the movement of matter during photosynthesis, and the inputs and outputs of photosynthesis. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analyzing data, observations, or investigations to explain how photosynthesis supports energy flow and matter cycling in ecosystems. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.SL.1.2 Explain how matter cycles through ecosystems as organisms interact with their environment.

Example: Students examine how mangrove plants obtain matter from the environment, how that matter moves through organisms as they feed, and how decomposition returns matter to the environment.

Student Task(s) –

Use a model to trace matter from the nonliving environment into mangrove plants and then through feeding relationships.

Identify where matter moves between organisms and the environment.

Explain how decomposition returns matter to the environment.

Use evidence from the model to explain why matter is cycled rather than continually lost from the ecosystem.

Benchmark Clarifications:

Clarification 1: Instruction includes that matter moves between living organisms and the non-living environment as organisms obtain matter from the environment and return it through processes such as feeding and decomposition.

Clarification 2: Instruction includes identifying patterns in and comparing pathways through which matter moves within ecosystems.

Clarification 3: Instruction includes using models or diagrams to represent matter cycling in ecosystems. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes analyzing data and evidence to explain how matter cycles between organisms and the environment. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.SL.2 Analyze how populations change over time in response to environmental conditions and limiting factors.

SC.7.SL.2.1 Explain how populations change over time as a result of births, deaths, immigration, emigration, and limiting factors.

Example: Students examine population data showing changes in the number of manatees in a Florida coastal area over several years and consider how births, deaths, movement into or out of the area, and limiting factors may contribute to those changes.

Student Task(s) –

Analyze the population data and identify patterns in population size over time.

Identify possible effects of births, deaths, immigration, and emigration on changes in the population.

Use information about environmental conditions to identify limiting factors that could affect manatee population size, growth, or survival.

Explain how demographic processes and limiting factors could account for the observed population changes.

Benchmark Clarifications:

Clarification 1: Instruction includes that population size changes over time based on the relationship among births, deaths, immigration, and emigration.

Clarification 2: Instruction includes limiting factors, such as food, water, space, shelter, disease, and predation, that influence population size, growth, and survival.

Clarification 3: Instruction includes analyzing data, graphs, and scenarios to identify patterns and explain how populations change in response to environmental conditions over time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as population graphs or system diagrams to represent changes in population size over time. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analyzing data and evidence from investigations or scenarios to explain changes in population size. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Grade 8

SC.8.SL.1 Analyze how energy flows and matter cycles through ecosystems and how interactions and disruptions affect system stability and change over time.

SC.8.SL.1.1 Analyze pathways of energy flow and matter cycling in a food web.

Example: Students examine a food web containing sawgrass, aquatic invertebrates, fish, wading birds, and decomposers. They investigate how a change in one population could affect pathways of energy flow and matter cycling through the food web.

Student Task(s) –

Trace pathways of energy from producers through consumers in the food web.

Identify pathways through which matter moves among organisms and returns to the environment.

Analyze how a change in one population could affect other components of the food web.

Use the food-web model and provided evidence to explain differences between the movement of energy and the cycling of matter.

Benchmark Clarifications:

Clarification 1: Instruction includes that producers capture energy through photosynthesis or chemosynthesis and incorporate matter from the environment into living systems.

Clarification 2: Instruction includes that energy and matter are transferred from producers to consumers and between consumers, while decomposers return matter to the environment.

Clarification 3: Instruction includes that energy flows in one direction through food webs, while matter cycles within ecosystems.

Clarification 4: Instruction includes identifying patterns in energy flow and matter cycling within food webs.

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Clarification 5: Instruction is limited to analyzing pathways of energy flow and matter cycling within food webs and excludes quantitative calculations of energy transfer. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as food webs and diagrams to represent pathways of energy flow and matter cycling. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analyzing data or scenarios to explain energy flow and matter cycling in ecosystems. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.SL.1.2 Model the carbon cycle to explain how matter and energy transfer within and between organisms and their environment.

Example: Students model how carbon moves among the atmosphere, pine trees, animals, soil, and decomposers through photosynthesis, feeding, respiration, and decomposition, and examine how wildfire can return stored carbon to the atmosphere through combustion.

Student Task(s) –

Use a model to trace carbon as it moves among the atmosphere, living organisms, and soil.

Identify the processes responsible for moving carbon between the components of the system.

Explain how energy transfer is associated with processes such as photosynthesis, feeding, and respiration.

Analyze provided data about carbon stored in different components of the ecosystem to identify patterns in carbon movement.

Benchmark Clarifications:

Clarification 1: Instruction includes the movement of carbon through processes such as photosynthesis, respiration, decomposition, and combustion.

Clarification 2: Instruction includes the transfer of carbon among Earth's systems, including the atmosphere, biosphere, and geosphere.

Clarification 3: Instruction includes explaining how carbon cycles through biological and Earth systems and how energy transfer is associated with processes within the carbon cycle.

Clarification 4: Instruction excludes quantitative calculations of carbon fluxes and detailed biochemical pathways.

Clarification 5: Instruction includes identifying patterns in how carbon is cycled through biological and environmental systems. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or cycle representations to illustrate pathways of carbon movement within and between systems. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analyzing data or scenarios to explain how carbon moves through ecosystems. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.SL.1.3 Analyze how disruptions to physical or biological components of ecosystems affect populations.

Example: Case Study – Following Hurricane Irma (2017), storm surge and disturbed soil conditions in South Florida allowed the invasive Brazilian pepper tree to spread rapidly into coastal habitats such as mangroves and wetlands. This spread outcompeted native plants, reducing habitat and food sources for species like wading birds and small fish. Over several years, scientists recorded declines in native plant diversity and shifts in animal population numbers.

Student Task(s) –

Analyze the provided population data and ecosystem model to identify patterns and explain how the hurricane and invasive species affected populations within the ecosystem.

Use evidence from the data and model to explain cause-and-effect relationships between the disruptions and changes in populations.

Benchmark Clarifications:

Clarification 1: Instruction includes physical disruptions including weather events, pollution, habitat loss, and biological disruptions such as invasive species and disease.

Clarification 2: Instruction includes using empirical evidence to describe and explain population changes in response to disruptions.

Clarification 3: Instruction is limited to analyzing observable or provided evidence of population changes following ecosystem disruptions and excludes mathematical modeling of population dynamics.

Clarification 4: Instruction includes identifying patterns and trends in population data following ecosystem disruptions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using ecosystem models to predict potential population changes following disruptions. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analyzing data and evidence to explain how disruptions affect populations. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.SL.1.4 Evaluate strategies for maintaining biodiversity and reducing anthropogenic impact on ecosystems.

Example: Students compare two strategies for protecting a coastal ecosystem, such as restoring native vegetation and establishing protected areas. They examine population trends and environmental indicators to determine how effectively each strategy supports biodiversity and ecosystem stability.

Student Task(s) –

Analyze the provided data to identify patterns in population trends and environmental indicators following implementation of each strategy.

Compare the outcomes of the two strategies using evidence from the data.

Evaluate which strategy is more effective for maintaining biodiversity and explain the evidence supporting the conclusion.

Benchmark Clarifications:

Clarification 1: Instruction includes strategies for maintaining biodiversity and reducing anthropogenic impact, including conservation, restoration, and resource management.

Clarification 2: Instruction includes analyzing scientific data such as population trends and environmental indicators to evaluate the effectiveness of strategies.

Clarification 3: Instruction includes using evidence to compare outcomes of different strategies for maintaining ecosystem stability and biodiversity.

Clarification 4: Instruction includes identifying patterns and trends in data to compare impacts of different environmental strategies. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as ecosystem diagrams or scenario models to represent the effects of strategies on ecosystems. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analyzing data and evidence to evaluate the effectiveness of strategies for maintaining biodiversity. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.SL.1.5 Explain how different groups of organisms interact and depend on each other within ecosystems.

Example: Students examine relationships among corals, algae, fish, microorganisms, and other organisms in a Florida coral reef ecosystem, including how organisms depend on one another for energy, resources, and survival.

Student Task(s) –

Use an ecosystem model to identify interactions among different groups of organisms.

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Explain how selected organisms depend on one another for energy, resources, or survival.

Analyze evidence to explain how changes in one interaction could affect other organisms or ecosystem function.

Benchmark Clarifications:

Clarification 1: Instruction includes interactions among organisms such as plants, animals, fungi, and microorganisms within ecosystems.

Clarification 2: Instruction includes how different groups of organisms depend on one another for energy, resources, and survival.

Clarification 3: Instruction includes relationships such as mutualism, commensalism, parasitism, predation, and decomposition in supporting ecosystem function.

Clarification 4: Instruction includes identifying patterns in relationships among organisms and how these interactions influence ecosystem stability. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as food webs, interaction diagrams, or ecosystem models to represent relationships among organisms. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analyzing data or scenarios to explain how interactions among organisms affect ecosystem function. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.SL.2 Analyze how inherited traits and environmental conditions influence changes in populations over time.

SC.8.SL.2.1 Recognize the requirements for natural selection to occur in a population.

Example: Case Study – In a population of lizards living on a Florida island, some individuals have longer legs while others have shorter legs; after a series of storms, vegetation changes

make it easier for longer-legged lizards to escape predators and find food. Over several generations, scientists observed changes in trait distribution within the population.

Student Task(s) –

Use the data provided and model to identify patterns in trait variation, survival, and reproduction within the lizard population.

Explain how the conditions of variation, inheritance, overproduction, and differential survival contribute to natural selection in this population.

Benchmark Clarifications:

Clarification 1: Instruction includes the conditions required for natural selection, including variation in traits, inheritance of traits, overproduction of organisms, and differential survival and reproduction.

Clarification 2: Instruction excludes detailed molecular mechanisms of inheritance and population genetics.

Clarification 3: Instruction includes identifying patterns in trait variation and survival within populations. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models to illustrate the conditions required for natural selection and how those conditions influence trait distributions within populations. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.8.SL.2.2 Explain how inherited traits and variation within a population influence survival and reproduction in changing environments.

Example: Case Study – In a population of native Florida marsh rabbits living in coastal salt marshes, individuals vary in fur color from light brown to darker gray. Following increased coastal flooding and vegetation changes due to storm activity, the marsh environment becomes darker and provides better camouflage for rabbits with darker fur. Over several generations, scientists collect data showing higher survival rates and greater reproduction among darker-furred rabbits.

Student Task(s) –

Analyze the provided data and trait distribution model to identify patterns in how variation in inherited fur color influences survival and reproduction in this changing environment.

Use evidence from the data to explain how differences in inherited fur color influence survival and reproduction among marsh rabbits in the changing environment.

Benchmark Clarifications:

Clarification 1: Instruction includes that individuals within a population vary in inherited traits.

Clarification 2: Instruction includes that certain traits increase the likelihood of survival and reproduction under specific environmental conditions.

Clarification 3: Instruction includes that advantageous traits may become more common in a population over time, connecting variation to natural selection.

Clarification 4: Instruction includes analyzing scenarios or data to explain relationships between traits and survival.

Clarification 5: Instruction excludes molecular mechanisms of inheritance and quantitative population-genetics models.

Clarification 6: Instruction includes identifying patterns and trends in how traits change within populations over time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes using models such as trait distribution diagrams to represent variation within populations. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analysis of data and evidence to explain how variation influences survival and reproduction. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.SL.2.3 Investigate natural selection as a process in which traits in a population may change over time in response to environmental conditions.

Example: Students are provided with data and visual models showing changes in traits within a population of spotted sea trout living in seagrass beds along the northern Gulf Coast of Florida. Over time, the seagrass habitat has changed due to decreased water clarity and a decline in seagrass coverage, resulting in darker and patchier habitat conditions. The data show how the frequency of body coloration patterns in the spotted sea trout population changes over multiple years as these environmental conditions shift.

Student Task(s) –

Analyze the data and models to identify patterns in how the frequency of body coloration traits in the spotted sea trout population changes over time in response to changes in water clarity and seagrass coverage.

Use evidence from the data and models to explain how changes in the environmental conditions may influence which traits become more common in the population over time through natural selection.

Benchmark Clarifications:

Clarification 1: Instruction includes that natural selection is the process by which certain traits become more common in a population over time.

Clarification 2: Instruction includes analysis of data and models to explain how environmental conditions influence changes in traits within populations.

Clarification 3: Instruction excludes mathematical population-genetics models and mechanisms of genetic inheritance at the molecular level.

Clarification 4: Instruction includes identifying patterns and trends in trait frequency over time using data. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as graphs or population diagrams to represent changes in traits over time. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data and evidence to explain how traits in populations change over time. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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SC.8.SL.2.4 Distinguish between natural selection and artificial selection.

Example: Students are provided with two sets of information. The first describes a population of spotted seatrout in Florida seagrass beds experiencing changes in environmental conditions, along with data showing changes in body coloration traits across several generations. The second describes a population of domesticated dogs selected by humans for specific characteristics such as size and coat type, along with information showing how these traits change over generations.

Student Task(s) –

Analyze both examples to explain how the traits in each population change over time.

Compare the two processes by explaining how changes in traits in the seatrout population differ from changes in traits in the dog population, including the role of environmental conditions and human influence.

Benchmark Clarifications:

Clarification 1: Instruction includes that natural selection occurs through environmental pressures, while artificial selection is directed by human choices.

Clarification 2: Instruction includes that both natural and artificial selection act on existing variation within populations and can result in changes in the frequency of traits over generations.

Clarification 3: Instruction includes analysis of examples or data to compare how traits change over time under natural and artificial selection.

Clarification 4: Instruction includes identifying patterns in how traits change over generations under different selection processes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as comparison diagrams or charts to distinguish natural and artificial selection. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 6: Instruction includes analysis of data and evidence to compare outcomes of natural and artificial selection. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.SL.3 Evaluate evidence used to explain patterns in how organisms and Earth have changed over time.

SC.8.SL.3.1 Identify and evaluate evidence used to explain patterns in how organisms change over time.

Example: Case Study – Students examine fossil records, comparative anatomical evidence, and genetic evidence from several species related to modern horses. The evidence shows changes in body structure and relationships among species over time.

Student Task(s) –

Analyze the different sources of evidence to identify patterns in how horse characteristics changed over time.

Compare what each source of evidence reveals about relationships among organisms.

Evaluate how the combined evidence supports an explanation for changes in horses over time.

Benchmark Clarifications:

Clarification 1: Instruction includes that patterns in how organisms change over time are explained by changes in inherited traits supported by scientific evidence.

Clarification 2: Instruction includes sources of evidence such as fossil records, comparative anatomy, and genetic information used to examine similarities, differences, and changes among organisms.

Clarification 3: Instruction includes evaluating evidence to explain patterns of change among organisms over time.

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Clarification 4: Instruction excludes detailed mechanisms of molecular evolution and population genetics.

Clarification 5: Instruction includes identifying patterns and relationships in evidence used to explain changes among organisms. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or comparative representations to explain relationships among organisms. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of multiple sources of data and evidence to support explanations of how organisms change over time. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes that scientific understanding of how organisms change over time has developed based on evidence. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

SC.8.SL.3.2 Analyze the fossil record to show that life forms have changed over time.

Example: Case Study – Students examine a sequence of fossil specimens from different rock layers representing related organisms. The specimens show differences in body structures and diversity across the sequence.

Student Task(s) –

Analyze the fossil evidence to identify patterns in how the organisms' structures and diversity change across the sequence.

Use the evidence to explain how the fossil record supports the conclusion that life forms have changed over time.

Benchmark Clarifications:

Clarification 1: Instruction includes analysis of fossil record evidence to identify patterns of change in structure and diversity of organisms over time.

Clarification 2: Instruction includes identifying patterns and trends in fossil data to explain changes in organisms. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using models such as fossil sequences or diagrams to represent changes in organisms over time. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes analysis of fossil data and evidence to explain how life forms have changed over time. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes that fossil evidence has contributed to the development of scientific understanding of changes in life over time. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

SC.8.SL.3.3 Recognize methods used to determine the relative and absolute ages of Earth's rocks, fossils, and artifacts, including the law of superposition and radiometric dating.

Example: Students examine a diagram showing several layers of sedimentary rock containing fossils and use the law of superposition to determine the relative ages of the layers. Students then examine information about a volcanic rock layer dated using radiometric methods and explain how the radiometric date provides an estimate of its absolute age.

Student Task(s) –

Use the order of the rock layers to determine which fossils are relatively older or younger.

Explain how the law of superposition is used to determine relative age.

Distinguish between the relative age information provided by the rock layers and the absolute age estimate provided by radiometric dating.

Benchmark Clarifications:

Clarification 1: Instruction is limited to a conceptual understanding of methods used to determine relative age and absolute age, including the law of superposition and radiometric dating, and excludes calculations.

Clarification 2: Instruction includes using evidence from scenarios to make predictions about the relative age of rocks, fossils, and artifacts.

Clarification 3: Instruction includes identifying patterns in sequences, such as layer order, to determine relative age. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as layered diagrams to represent relationships among rock and fossil ages. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analysis of evidence from scenarios to determine relative age relationships. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes that methods used to determine the age of rocks and fossils have been developed and refined over time based on scientific evidence. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

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The Science of Cell Biology

How cells are structured and regulated, how they communicate and manage energy, grow and divide, and pass on genetic information that drives development, function, and the continuity of life.

Grade 6

SC.6.CB.1 Explain how living systems are organized from simple to complex structures and how cells form the foundation of all living organisms.

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SC.6.CB.1.1 Explain that organisms are structured in increasing complexity from atoms to organisms.

Example: Students examine a model showing how atoms combine to form molecules, molecules are organized within cells, and cells are organized to form increasingly complex structures in multicellular organisms.

Student Task(s) –

Use the model to identify how each level builds on the structures at the preceding level.

Explain how organization at smaller levels contributes to increasing complexity in multicellular organisms.

Benchmark Clarifications:

Clarification 1: Instruction includes that living organisms are organized in increasing complexity from atoms to molecules to cells and, in multicellular organisms, through increasingly complex levels of organization that form organisms.

Clarification 2: Instruction is limited to a conceptual understanding that cells may become specialized and organized to support more complex structures, and excludes specific types of tissues, organs, or organ systems.

Clarification 3: Instruction includes identifying patterns in levels of biological organization from simple to complex. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models to represent hierarchical organization of biological structures from atoms to organisms. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.6.CB.1.2 Investigate that all living organisms are composed of cells.

Example: Students observe prepared plant and animal cells using microscopes or digital images and record evidence of cellular structures in each specimen.

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Student Task(s) –

Compare observations from the plant and animal specimens.

Use the collected observations to explain how the evidence supports the idea that living organisms are composed of cells.

Benchmark Clarifications:

Clarification 1: Instruction includes observing cells using microscopes or images from a variety of organisms, including plants and animals.

Clarification 2: Instruction includes using models such as cell diagrams to represent cellular structure. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes collecting and analyzing observational data to support the idea that all living organisms are composed of cells. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.CB.1.3 Recognize the principles of cell theory.

Example: Students examine historical observations and images of cells made with increasingly advanced microscopes and compare how these observations contributed to the development and refinement of cell theory.

Student Task(s) –

Identify how new observations provided evidence about cells.

Explain how the evidence contributed to the development or refinement of cell theory.

Use a model to represent the principles of cell theory and how scientific understanding changed as new evidence became available.

Benchmark Clarifications:

Clarification 1: Instruction includes that cell theory is based on scientific evidence.

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Clarification 2: Instruction includes that scientific models are developed and refined based on available evidence.

Clarification 3: Instruction is limited to a conceptual understanding of the development of cell theory and excludes memorization of specific scientists or dates.

Clarification 4: Instruction includes using models to represent the principles of cell theory and understanding how models are refined over time. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analysis of evidence to support the principles of cell theory. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes that cell theory was developed from scientific evidence and has been refined as new evidence and technologies have improved scientific understanding. Refer to Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

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SC.6.CB.2 Explain the structure and characteristics of cells and how different types of cells are organized.

SC.6.CB.2.1 Recognize the components common to all cells.

Example: Students examine diagrams or microscope images of bacterial, protist, fungal, plant, and animal cells and compare the cell components present in each type.

Student Task(s) –

Identify the components shared by the different cell types.

Use evidence from the provided representations to explain how the shared components demonstrate similarities among cells.

Compare the functions of the shared components across the different cell types.

Benchmark Clarifications:

Clarification 1: Instruction includes the components common to all cells: cell membrane, cytoplasm, ribosomes, and genetic material (deoxyribonucleic acid [DNA]) and their functions.

Clarification 2: Instruction includes that these components are present across different cell types,

including bacteria, protists, fungi, plants, and animals.

Clarification 3: Instruction includes identifying patterns in similarities among different cell types based on shared components. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as diagrams or cell representations to identify and describe cell components and their functions. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.6.CB.2.2 Distinguish between the characteristics of prokaryotic and eukaryotic cells.

Example: Students examine diagrams or microscope images representing a bacterial cell and a eukaryotic cell and compare their cellular organization.

Student Task(s) –

Identify similarities and differences between the two cell types using the provided representations.

Explain how the presence or absence of a nucleus distinguishes prokaryotic and eukaryotic cells.

Benchmark Clarifications:

Clarification 1: Instruction includes distinguishing characteristics of prokaryotic and eukaryotic cells, including the presence or absence of a nucleus and differences in cellular organization.

Clarification 2: Instruction includes identifying patterns in structural similarities and differences between cell types. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 3: Instruction includes using models such as comparison charts or diagrams to distinguish between prokaryotic and eukaryotic cells. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.6.CB.2.3 Distinguish the characteristics of plant cells and animal cells.

Example: Students observe prepared plant and animal cells using microscopes or digital microscope images and compare the structures visible in each type of cell.

Student Task(s) –

Record observations of the structures visible in each cell type.

Identify similarities and differences between plant and animal cells using evidence from the observations.

Explain how the observed structures distinguish plant cells from animal cells.

Benchmark Clarifications:

Clarification 1: Instruction includes the use of microscopes or images to observe similarities and differences between plant and animal cells.

Clarification 2: Instruction includes identifying patterns in similarities and differences between plant and animal cells. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using models such as diagrams, images, or physical representations to compare plant and animal cell structures. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes collecting and analyzing observational data from microscopes or images to distinguish cell characteristics. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.CB.2.4 Recognize that genetic material is organized as deoxyribonucleic acid (DNA).

Example: Students examine a model showing the organization of genetic information from deoxyribonucleic acid (DNA) to genes to chromosomes.

Student Task(s) –

Use the model to identify the relationship among DNA, genes, and chromosomes.

Explain how genes are organized within chromosomes as parts of DNA.

Use the model to describe how genetic information is organized within cells.

Benchmark Clarifications:

Clarification 1: Instruction includes that deoxyribonucleic acid (DNA) is the genetic material, that genes are composed of DNA, and that chromosomes contain many genes.

Clarification 2: Instruction includes identifying patterns in the organization of genetic information from DNA to genes to chromosomes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using models such as DNA diagrams, chromosome models, or gene representations to illustrate the organization of genetic information. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes that scientific understanding of DNA, and the organization of genetic information has developed over time as new evidence and technologies improved scientists' ability to study cells and heredity. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

SC.6.CB.3 Explain how cells function to support life processes and maintain the survival of living organisms.

SC.6.CB.3.1 Describe the function of cell components in plant cells and animal cells to support the homeostasis and survival of living organisms.

Example: Students examine a model of a plant cell and a model of an animal cell and identify how different cell components contribute to cellular processes that support homeostasis and survival.

Student Task(s) –

Identify the functions of the specified cell components using the models.

Explain how selected cell components work together to support processes such as obtaining energy, transporting materials, and removing waste.

Compare how cell components contribute to maintaining homeostasis in plant and animal cells.

Benchmark Clarifications:

Clarification 1: Instruction is limited to the following cell components in supporting cell structure and processes: cell membrane, cell wall, chloroplast, cytoplasm, mitochondria, nucleus, ribosome, and vacuole.

Clarification 2: Instruction includes that cells maintain homeostasis through processes such as energy transformation, transport of materials, and waste removal.

Clarification 3: Instruction includes identifying patterns in how different cell structures contribute to maintaining homeostasis. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as diagrams or representations to explain how cell components support cellular function and homeostasis. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analysis of observations or evidence to explain how cell structures support life processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.CB.3.2 Explain that living organisms require energy to carry out life processes.

Example: Students examine three organisms: a sunflower plant, a white-tailed deer, and a freshwater fish. They review information about how each organism uses energy for growth, movement, and reproduction. The information includes observations such as a growing sunflower producing new leaves, a deer using energy to move and search for food, and a fish using energy for movement and reproduction.

Student Task(s) –

Identify the life processes represented in the observations.

Compare how the three organisms use energy to carry out growth, movement, and reproduction.

Explain why energy is necessary for each of these life processes.

Benchmark Clarifications:

Clarification 1: Instruction includes that organisms require energy to carry out life processes such as growth, movement, and reproduction.

Clarification 2: Instruction includes identifying patterns in how energy is used across different life processes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using models such as flow diagrams to represent how energy supports life processes. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes analysis of observations or data to explain how organisms use energy to carry out life processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.CB.3.3 Recognize that all living organisms are composed of cells, use energy, maintain homeostasis, grow, reproduce, respond to stimuli, and adapt over time.

Example: Students examine a freshwater pond ecosystem and compare observations of several organisms, including a water lily, a fish, and a freshwater snail. The observations show organisms obtaining and using energy, growing, responding to changes in their environment and carrying out processes necessary for survival.

Student Task(s) –

Identify the life processes represented in the observations.

Explain how the observed life processes depend on cellular functions.

Use a model to represent how multiple life processes work together to maintain the organism and support survival.

Benchmark Clarifications:

Clarification 1: Instruction includes that metabolism is a series of chemical reactions that support homeostasis.

Clarification 2: Instruction is limited to a conceptual understanding of metabolism and excludes detailed chemical equations or pathways.

Clarification 3: Instruction includes identifying patterns in how organisms carry out life processes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models to represent how life processes work together to maintain homeostasis. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analysis of evidence or observations to identify characteristics of living organisms. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Grade 7

SC.7.CB.1 Explain how cells obtain, transform, and use energy and matter through key biological processes.

SC.7.CB.1.1 Recognize that cellular respiration converts chemical energy from food into usable energy for the cell.

Example: Students investigate the relationship between cellular respiration and energy use by examining data from germinating seeds. The data include measurements of oxygen consumption and carbon dioxide production over a period of time as the seeds begin to grow. Students use the data as evidence that cellular respiration is occurring and connect the process to the energy needed for growth.

Student Task(s) –

Analyze the oxygen and carbon dioxide data to identify patterns associated with cellular respiration.

Explain how the data provide evidence that the germinating seeds are carrying out cellular respiration.

Explain how cellular respiration makes chemical energy from food available for cellular processes such as growth.

Benchmark Clarifications:

Clarification 1: Instructions include that cellular respiration converts chemical energy from food into usable energy for the cell and is a key part of metabolism.

Clarification 2: Instruction is limited to the concept of cellular respiration as the breakdown of glucose to release usable energy for cellular processes and excludes detailed chemical reactions.

Clarification 3: Instruction includes identifying patterns in how energy is transformed within cells. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as diagrams or flow representations to illustrate how cellular respiration converts energy. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analysis of observations or data to explain how cells obtain and use energy. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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SC.7.CB.1.2 Model how cellular respiration contributes to the cycling of carbon in ecosystems.

Example: Students examine a model of a forest ecosystem that includes trees, deer, fungi, and soil. The model shows carbon dioxide entering trees during photosynthesis, carbon becoming part of food molecules in plants, and carbon dioxide being released when plants, animals, and fungi carry out cellular respiration. Students trace the movement of carbon through the ecosystem and identify how cellular respiration returns carbon dioxide to the environment.

Student Task(s) –

Use the model to trace carbon from carbon dioxide in the environment into living organisms and back into the environment through cellular respiration.

Identify where cellular respiration occurs in the carbon pathway represented in the model.

Revise or annotate the model to show how cellular respiration contributes to continuous carbon cycling.

Explain how cellular respiration moves carbon from living organisms back to the environment.

Benchmark Clarifications:

Clarification 1: Instruction includes that cellular respiration occurs in both terrestrial and aquatic ecosystems and transforms carbon in glucose into carbon dioxide, transferring carbon from living organisms to the environment.

Clarification 2: Instruction includes identifying patterns in how carbon moves between organisms and the environment through cellular respiration. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using and evaluating models such as diagrams or simulations to represent how cellular respiration contributes to the cycling of carbon in ecosystems. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes analysis of data or scenarios to explain how cellular respiration contributes to carbon cycling. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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SC.7.CB.1.3 Model how photosynthesis contributes to the cycling of carbon in ecosystems.

Example: Students examine a model of a freshwater lake ecosystem that includes algae, aquatic plants, fish, and dissolved carbon dioxide. The model shows carbon dioxide in the water being taken up by algae and aquatic plants during photosynthesis and incorporated into glucose. Students trace the movement of carbon from the non-living environment into living organisms.

Student Task(s) –

Use the model to trace carbon from dissolved carbon dioxide into aquatic plants and algae through photosynthesis.

Identify where photosynthesis occurs in the carbon pathway represented in the model.

Annotate the model to show how photosynthesis transfers carbon from the non-living environment into living systems.

Explain how photosynthesis contributes to the cycling of carbon within the ecosystem.

Benchmark Clarifications:

Clarification 1: Instruction includes photosynthesis in both terrestrial and aquatic ecosystems and transforms carbon dioxide from the environment into carbon stored in glucose, moving carbon from the non-living environment into living systems.

Clarification 2: Instruction includes identifying patterns in how carbon is transferred between the environment and living organisms. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using and evaluating models such as diagrams, simulations, or analogies to represent how photosynthesis contributes to the carbon cycle. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 4: Instruction includes analysis of data or observations to explain how photosynthesis contributes to carbon cycling. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.CB.2 Explain how genetic information is stored and passed from one generation to the next.

SC.7.CB.2.1 Recognize that deoxyribonucleic acid (DNA) contains instructions for traits and that heredity is the transmission of genetic information from one generation to the next.

Example: Students examine a family pedigree showing the presence or absence of a particular inherited trait across three generations. The pedigree identifies which individuals have the trait and the relationships among parents, children, siblings, and grandparents. Students use the pattern of the trait across generations to investigate how genetic information can be transmitted from parents to offspring.

Student Task(s) –

Analyze the pedigree to identify patterns in how the trait appears across generations.

Identify examples of parents transmitting genetic information to their offspring.

Use the evidence in the pedigree to explain how heredity results in the transmission of genetic information from one generation to the next.

Benchmark Clarifications:

Clarification 1: Instruction includes that DNA contains genetic information that influences traits and that heredity is the transmission of genetic information from one generation to the next.

Clarification 2: Instruction includes identifying patterns in how traits are passed from parents to offspring. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using models such as diagrams or representations to illustrate how genetic information is stored and passed through generations. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes analysis of evidence or simple data to identify how traits are inherited across generations. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes that scientific understanding of DNA and heredity has developed over time through new evidence and advances in technology. Refer to Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

SC.7.CB.2.2 Predict genotype and phenotype outcomes of offspring using Punnett squares.

Example: In a population of fruit flies, red eyes are a dominant trait, and white eyes are a recessive trait. Students are given the genotypes of two parent flies: one heterozygous, red-eyed fly and one homozygous, recessive, white-eyed fly.

Student Task(s) –

Construct a Punnett square representing the cross.

Determine the possible genotypes and phenotypes of the offspring.

Use probability to predict the proportion of offspring expected to have red eyes and white eyes.

Explain how the predicted genotype and phenotype outcomes are related.

Benchmark Clarifications:

Clarification 1: Instruction is limited to single-trait crosses involving simple dominant and recessive inheritance.

Clarification 2: Instruction excludes complex inheritance patterns such as incomplete dominance, codominance, polygenic traits, multiple alleles, or sex-linked traits.

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Clarification 3: Instruction includes applying proportional reasoning and probability to predict genotype and phenotype outcomes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as Punnett squares to represent inheritance patterns and predict outcomes. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analysis of data or results from crosses to explain inheritance patterns. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.CB.3 Explain how organisms reproduce and how inheritance patterns result in variation among offspring.

SC.7.CB.3.1 Distinguish between sexual and asexual reproduction and their roles in producing offspring and influencing genetic variation.

Example: Students compare reproduction in a strawberry plant and a sea turtle. Strawberry plants can produce new plants asexually through runners, resulting in offspring that are genetically similar to the parent plant. Sea turtles reproduce sexually, with offspring receiving genetic information from two parents and showing variation in inherited traits.

Student Task(s) –

Compare the reproductive processes used by the two organisms.

Identify which process is asexual and which is sexual.

Analyze information about the offspring to identify patterns in genetic similarity and variation.

Explain how the type of reproduction influences genetic variation among offspring.

Benchmark Clarifications:

Clarification 1: Instruction includes that prokaryotes reproduce asexually while eukaryotes may reproduce asexually or sexually.

Clarification 2: Instruction includes that sexual reproduction produces offspring with genetic variation, while asexual reproduction generally produces offspring that are genetically similar to the parent. Clarification 3: Instruction includes that asexual reproduction involves processes such as binary fission and mitosis, while sexual reproduction involves meiosis to produce gametes.

Clarification 4: Instruction is limited to the conceptual understanding of sexual and asexual reproduction and excludes detailed phases of mitosis or meiosis.

Clarification 5: Instruction includes identifying patterns in genetic similarity and variation among offspring. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or comparison charts to distinguish between sexual and asexual reproduction. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of data or examples to explain how different reproduction methods affect offspring traits. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Grade 8

SC.8.CB.1 Explain how chemical reactions in cells transform matter and energy to support life.

SC.8.CB.1.1 Model the process of cellular respiration by identifying the reactants and products.

Example: Students are provided with a model of cellular respiration showing glucose and oxygen entering the process and carbon dioxide, water, and adenosine triphosphate (ATP) being produced. Students use the model to identify the reactants and products and describe how matter and energy are represented in the process.

Student Task(s) –

Identify the reactants and products represented in the model.

Match each reactant and product with its name and, where provided, its chemical formula.

Use the model to explain how glucose and oxygen are used during cellular respiration and how carbon dioxide, water, and ATP are produced.

Identify patterns in the relationship between the inputs and outputs represented in the model.

Benchmark Clarifications:

Clarification 1: Instruction includes that the reactants of cellular respiration are glucose and oxygen and the products include carbon dioxide, water, and usable energy (adenosine triphosphate (ATP)).

Clarification 2: Instruction includes identifying patterns in the relationship between reactants and products in cellular respiration. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using models such as diagrams, flow representations, or analogies to represent the process of cellular respiration and identify reactants and products. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes analysis of data or observations to explain inputs and outputs of cellular respiration. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.CB.1.2 Recognize that cellular respiration is a chemical reaction described by a chemical equation.

Example: Students investigate how cellular respiration occurs in germinating seeds placed in a sealed container. Over time, they measure changes in oxygen and carbon dioxide levels. They are provided with the chemical equation for cellular respiration:

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy (ATP)

The students use the equation and the data to connect the substances represented in the chemical equation to the changes observed during the investigation.

Time (hours)	Oxygen (ppm)	Carbon Dioxide (ppm)
0	21	0.04
2	19	0.08
4	17	0.12
6	15	0.18
8	13	0.25

Student Task(s) –

Identify the reactants and products in the cellular respiration equation by name and chemical formula.

Use the equation to explain the relationship between the substances used and produced during cellular respiration.

Analyze the data to identify patterns in oxygen and carbon dioxide levels over time.

Use the equation and data as evidence to explain how the observed changes are consistent with cellular respiration occurring in germinating seeds and how these patterns provide evidence that matter is transformed during cellular respiration.

Benchmark Clarifications:

Clarification 1: Instruction includes that cellular respiration is a chemical reaction in which glucose and oxygen are used to produce carbon dioxide, water, and usable energy (ATP).

Clarification 2: Instruction includes the chemical equation for cellular respiration.

Clarification 3: Instruction includes identifying reactants and products by name and chemical formula and excludes balancing chemical equations.

Clarification 4: Instruction includes identifying patterns in relationships between reactants and products in the equation. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 5: Instruction includes using chemical equations as models to represent cellular respiration. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data to explain how cellular respiration functions as a chemical process. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.CB.1.3 Recognize that photosynthesis is a chemical reaction described by a chemical equation.

Example: Students investigate photosynthesis in aquatic plants placed in a school lab tank exposed to different amounts of light. Over the course of the investigation (one day), they measure oxygen and carbon dioxide levels in the water at different light intensities. Students are provided with the chemical equation for photosynthesis:

(C6O_2 + 6H_2 O+light energy→ C_6 H_12 O_6+ 6O_2)

Students use the equation and the data to connect the substances represented in the chemical equation to the changes observed during the investigation.

Data Table:

Light Exposure (hours of sunlight)	Carbon Dioxide (ppm)	Oxygen (ppm)
0	40	4
2	35	6
4	30	9
6	25	12
8	20	15

Student Task(s) –

Identify the reactants and products in the photosynthesis equation by name and chemical formula.

Describe the role of light energy in the chemical reaction and how it relates to sunlight.

Analyze the data to identify patterns in carbon dioxide and oxygen levels as light exposure increases.

Use the equation and the data as evidence to explain how the observed changes are consistent with photosynthesis occurring in the aquatic plants and how these patterns provide evidence of matter being transformed during photosynthesis.

Benchmark Clarifications:

Clarification 1: Instruction includes that photosynthesis is a chemical reaction in which carbon dioxide, water, and energy (sunlight) are used to produce glucose and oxygen.

Clarification 2: Instruction includes the chemical equation for photosynthesis.

Clarification 3: Instruction includes identifying reactants and products by name and chemical formula and excludes balancing chemical equations.

Clarification 4: Instruction includes identifying patterns in relationships between reactants and products in the equation. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using chemical equations as models to represent photosynthesis. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data to explain how photosynthesis functions as a chemical process. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.CB.2 Explain how cellular processes interact to transfer energy and cycle matter within and between organisms and environments.

SC.8.CB.2.1 Explain photosynthesis and cellular respiration as complementary processes.

Example: Students are provided with chemical equations for photosynthesis and cellular respiration along with a model showing the exchange of substances between a green plant and an animal. The model shows carbon dioxide and water moving toward the plant, glucose and oxygen moving from the plant to the animal, and carbon dioxide and water returning from the animal to the environment. Students use the equations and model to identify how the products of one process relate to the reactants of the other.

Student Task(s) –

Use the two chemical equations to identify the products of photosynthesis that are used as reactants in cellular respiration.

Identify the products of cellular respiration that can be used as reactants in photosynthesis.

Trace the movement of carbon through the two processes using the model.

Explain how photosynthesis and cellular respiration are complementary processes that transfer matter and energy between living organisms and their environment.

Benchmark Clarifications:

Clarification 1: Instruction includes that the products of photosynthesis (glucose and oxygen) serve as the reactants for cellular respiration and the products of cellular respiration (carbon dioxide and water) serve as the reactants for photosynthesis.

Clarification 2: Instruction includes that photosynthesis removes carbon dioxide from the environment, while cellular respiration returns carbon dioxide to the environment.

Clarification 3: Instruction includes identifying patterns in how matter moves and how energy is transformed through the complementary processes of photosynthesis and cellular respiration. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as diagrams or cycle representations to illustrate the relationships between photosynthesis and cellular respiration. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analysis of data or evidence from scenarios to explain how the two processes are related. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Proposed DRAFT Standards

SC.8.CB.2.2 Use evidence to explain that photosynthesis and cellular respiration conserve matter by transforming carbon without creating or destroying it.

Example: Students examine models and data showing carbon moving through photosynthesis and cellular respiration. Students trace carbon atoms through both processes and use evidence to explain how matter is transformed but conserved.

Student Task(s) –

- Trace carbon through both processes.
- Identify where carbon appears in reactants and products.
- Use evidence to explain conservation of matter.
- Explain why carbon is transformed rather than created or destroyed.

Benchmark Clarifications:

Clarification 1: Instruction includes that the Law of Conservation of Mass states that matter is not created or destroyed during chemical reactions.

Clarification 2: Instruction includes that carbon is transformed from carbon dioxide into glucose during photosynthesis and from glucose into carbon dioxide during cellular respiration.

Clarification 3: Instruction excludes balancing chemical equations.

Clarification 4: Instruction includes identifying patterns in how carbon is transformed and conserved across processes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as diagrams or equations to represent conservation of mass in biological processes. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 6: Instruction includes analysis of data and evidence to demonstrate that matter is conserved during chemical processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.CB.3 Analyze how environmental conditions influence how cells obtain and use energy.

SC.8.CB.3.1 Recognize that organisms use different processes to obtain usable energy based on environmental conditions.

Benchmark Clarifications:

Clarification 1: Instruction includes that organisms may use aerobic processes when oxygen is available and anaerobic processes when oxygen is limited or absent.

Clarification 2: Instruction includes that aerobic cellular respiration in eukaryotic cells occurs in mitochondria, while anaerobic energy-releasing processes occur without oxygen.

Clarification 3: Instruction includes identifying patterns in how environmental conditions influence energy processes in organisms. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as diagrams or flow representations to compare aerobic and anaerobic processes. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analysis of data or scenarios to explain how organisms use different processes to obtain energy. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.CB.3.2 Analyze data to determine how environmental factors influence the rate of photosynthesis.

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Proposed DRAFT Standards

Example: Students examine data from an investigation of how temperature affects the rate of photosynthesis in spinach (Spinacia oleracea). Equal amounts of spinach leaf tissue are placed in water containing the same concentration of carbon dioxide and exposed to different temperatures. Students are provided with the amount of oxygen produced by the spinach at each temperature over the same period.

Data Table:

Temperature (°C)	Oxygen Produced (mL) in 10 Minutes
10	4.2
15	6.8
20	9.5
25	12.1
30	10.7
35	6.3

Student Task(s) –

Analyze the data to identify the pattern in oxygen production as temperature changes.

Determine the temperature at which the rate of photosynthesis is greatest based on the data.

Compare the amount of oxygen produced at different temperatures to determine how temperature influences the rate of photosynthesis.

Use evidence from the data to predict how the rate of photosynthesis would be affected by a further increase in temperature.

Benchmark Clarifications:

Clarification 1: Instruction includes environmental factors such as light intensity, temperature, and carbon dioxide concentration that may act as limiting factors that affect the rate of photosynthesis.

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Clarification 2: Instruction includes analyzing and interpreting tables, graphs, and models to identify patterns and relationships among environmental factors and photosynthesis rate and to predict how changes in environmental conditions influence photosynthesis. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using models such as graphs or diagrams to represent how environmental factors influence photosynthesis and to predict how changes in environmental conditions may affect photosynthesis rates. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes analysis of data and evidence to determine how environmental factors affect photosynthesis. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

The Science of Plants

How plant cells build and support whole organisms, capture and use energy, grow and reproduce, interact with their environments, and shape the ecosystems they sustain.

Grade 6

SC.6.P.1 Explain how plants capture light energy and use it to produce and use food through the process of photosynthesis.

SC.6.P.1.1 Recognize that chlorophyll is a pigment that absorbs light for photosynthesis.

Example: Students conduct an investigation using Elodea (waterweed) placed in a clear container filled with water. A light source, such as a lamp, is directed toward the plant. As the plant is exposed to light, students observe small bubbles forming on the leaves and rising to the surface as oxygen is produced during photosynthesis. Students place the Elodea at different distances from the light source while keeping other conditions consistent. They count the bubbles produced over the same period of time across repeated trials to improve reliability and compare the results. Students use observations

and data to identify patterns in oxygen production under different light conditions and draw conclusions about the role of chlorophyll in absorbing light energy for photosynthesis.

Student Task(s) –

Conduct the investigation and record your observations.

Analyze the investigation data to identify patterns in oxygen production under different light conditions.

Use the investigation evidence and a model of photosynthesis to explain the role of chlorophyll in photosynthesis.

Benchmark Clarifications:

Clarification 1: Instruction includes that chlorophyll is a pigment that absorbs light energy, gives plants their green color, and supports photosynthesis primarily in the green parts of plants, such as leaves.

Clarification 2: Instruction includes observing and measuring indicators of photosynthesis, such as oxygen production under different light conditions.

Clarification 3: Instruction includes identifying patterns in collected data, such as changes in oxygen production under different light conditions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as diagrams to represent how chlorophyll captures light energy during photosynthesis. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes designing and conducting investigations using repeated trials and replication, collecting data, and comparing observations, results, and conclusions. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes that scientific understanding of photosynthesis and the role of light in plant growth developed over time through scientific investigations and advances in technology. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

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SC.6.P.1.2 Model the process of photosynthesis by identifying its reactants and products.

Benchmark Clarifications:

Clarification 1: Instruction includes that water and carbon dioxide are the reactants in photosynthesis, light energy provides the energy for the process, and the products are glucose and oxygen.

Clarification 2: Instruction includes identifying patterns and relationships between reactants and products and between light availability and oxygen production. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using and evaluating models such as drawings, diagrams, three-dimensional representations, or analogies to represent how reactants are transformed into products during photosynthesis. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes distinguishing between inputs and outputs when modeling photosynthesis.

Clarification 5: Instruction includes using observations or investigation data to explain photosynthesis inputs, outputs, and processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes that scientific understanding of photosynthesis developed through evidence showing how plants transform matter and energy. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

SC.6.P.1.3 Distinguish how plants obtain the reactants for photosynthesis and how the products are used or released.

Benchmark Clarifications:

Clarification 1: Instruction includes that plants absorb water through roots, carbon dioxide enters through stomata, and chlorophyll in leaves absorbs light energy used in photosynthesis.

Clarification 2: Instruction includes that photosynthesis produces glucose and oxygen and that glucose is used or stored for growth, repair, and reproduction and that oxygen is released to the environment.

Clarification 3: Instruction includes identifying patterns in how environmental conditions influence photosynthesis products and their use or release. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models to illustrate how reactants enter plants and how products are used or released. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using observations or investigation data to explain how plants obtain reactants and use or release products of photosynthesis. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.P.2 Explain how plant structures support the ability to obtain resources and survive in different environments.

SC.6.P.2.1 Explain how plant structures support the ability of plants to obtain resources and survive in their environments.

Example: Students are provided with diagrams of native Florida plants, including a saw palmetto in sandy soils, a bald cypress tree in wetland conditions, and cordgrass along coastal shorelines. Each diagram includes information about sunlight availability, water levels, and air conditions in these environments.

Student Task(s) –

Identify the roles of the roots, stems, and leaves in obtaining water, nutrients, gases, and light from its environment.

Analyze and use evidence from the diagrams to explain how these structures help each plant obtain the resources it needs.

Identify similarities and differences in the structures of the saw palmetto, bald cypress, and cordgrass.

Explain how differences in plant structures are related to differences in environmental conditions and resource availability.

Use evidence from the diagrams to support the comparison.

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Benchmark Clarifications:

Clarification 1: Instruction includes major plant structures including roots, stems, and leaves and their roles in obtaining water, nutrients, gases, and light.

Clarification 2: Instruction includes how variations in plant structures and functions support survival in different environmental conditions and resource availability.

Clarification 3: Instruction includes identifying patterns in how plant structures relate to environmental conditions and resource acquisition. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using diagrams, illustrations, or other models to represent how plant structures support survival in different environments. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analyzing diagrams, images, observations or specimens to explain structure-function relationships in plants. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Grade 7

SC.7.P.1 Explain how plant structures and processes contribute to the movement of energy and matter in ecosystems.

SC.7.P.1.1 Explain how plant structures and processes contribute to energy flow and matter cycling in ecosystems.

Example: Students are provided with a diagram of a Florida mangrove estuary ecosystem, featuring a red mangrove tree along the shoreline. The diagram shows the roots, stems, and leaves of the red mangrove and how these structures support the plant's processes. Sunlight reaches the leaves, carbon dioxide enters the leaves, and glucose is produced and transported within the tree. Arrows illustrate how organisms such as small fish and crabs

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obtain matter, including carbon, and chemical energy by consuming materials from the mangrove, showing the movement of matter and energy through the food web.

Student Task(s) –

Use the diagram to explain how the roots, stems, and leaves of the red mangrove support processes that contribute to energy flow, such as photosynthesis and transformation of energy from the Sun into chemical energy stored in glucose, as well as matter cycling in the estuary ecosystem.

Explain how carbon stored in glucose moves from the mangrove tree to other organisms in the estuary ecosystem. Use evidence from the diagram to describe how matter and energy flow through the food web.

Benchmark Clarifications:

Clarification 1: Instruction includes that photosynthesis transforms energy from the Sun into chemical energy stored in glucose and incorporates matter from the environment into plant material that can enter food webs.

Clarification 2: Instruction includes the role of roots, stems, and leaves in supporting plant processes, including photosynthesis, and contributing to the movement of energy and matter through ecosystems.

Clarification 3: Instruction includes identifying patterns in energy flow and matter cycling through food webs and ecosystems. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as diagrams and food webs to illustrate how plants contribute to energy flow and matter cycling. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analyzing data, diagrams, observations, and scenarios to explain how plants contribute to energy flow and matter cycling in ecosystems. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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SC.7.P.2 Explain how plants grow, reproduce, and respond to environmental conditions that influence survival and population persistence.

SC.7.P.2.1 Explain how plant reproduction supports the continuation of plant populations.

Example: Students examine the reproduction of saw palmetto (Serenoa repens), a Florida native plant. They are provided with photographs and a diagram showing saw palmetto flowers, fruits, and seeds, along with information about how seeds are produced and dispersed. Students also examine a second example showing saw palmetto spreading asexually through stems that grow along or just below the soil surface. They use the representations to compare how sexual and asexual reproduction produce new plants and explain how both processes contribute to maintaining saw palmetto populations.

Student Task(s) –

Compare the two methods of saw palmetto reproduction shown in the representations.

Explain how each method produces new plants.

Use evidence from the representations to explain how sexual and asexual reproduction contribute to the continuation of a saw palmetto population.

Benchmark Clarifications:

Clarification 1: Instruction includes both sexual and asexual reproduction in plants.

Clarification 2: Instruction includes reproductive structures and products involved in plant reproduction, such as flowers, cones, seeds, and spores.

Clarification 3: Instruction is limited to a conceptual understanding of plant reproduction and excludes detailed reproductive anatomy or life cycles.

Clarification 4: Instruction includes identifying patterns in how plant populations change or remain stable based on reproduction. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as diagrams or other representations to illustrate how plants reproduce and maintain populations. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 6: Instruction includes analysis of observations, images, or scenarios to explain how plant reproduction occurs and supports population persistence. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes that scientific understanding of plant reproduction developed through observations and investigations of how plants produce offspring and maintain populations. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

SC.7.P.2.2 Analyze how environmental conditions influence plant growth, survival, and populations.

Example: Students investigate how water availability affects the growth and survival of sea oats (Uniola paniculata) growing on Florida coastal dunes. They are provided with data collected from three plots over an eight-week period. Each plot contains 20 sea oat plants at the beginning of the investigation. Plot A receives 1 liter of water per plant each week, Plot B receives 0.5 liters per plant each week and Plot C receives 0.25 liters per plant each week.

Data Table:

Water per plant per week	Average height at Week 1 (cm)	Average height at Week 8 (cm)	Plants surviving at Week 8
1.0 L	18	42	19
0.5 L	18	34	16
0.25 L	18	25	11

Students use the data to examine how water availability is related to plant growth, survival, and population size.

Student Task(s) –

Analyze the data to identify patterns in sea oat growth and survival under the three levels of water availability.

Use evidence from the data to explain how water availability influences plant growth, survival, and population size.

Benchmark Clarifications:

Clarification 1: Instruction includes environmental factors that influence plant growth and survival, such as light, water, temperature, and soil conditions and that limiting factors can restrict plant growth and population size.

Clarification 2: Instruction includes identifying patterns and relationships in how plant growth, survival, and population change under different environmental conditions, and predicting how environmental changes may affect plant populations. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 3: Instruction includes using models such as diagrams, graphs, or predictive models to represent how environmental conditions affect plant growth, survival, and population outcomes. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes analyzing experimental data, observations, or real-world scenarios to determine how environmental factors influence plant growth, survival, and populations. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Grade 8

SC.8.P.1 Analyze how photosynthesis supports energy flow and matter cycling in ecosystems and how environmental factors influence this process.

SC.8.P.1.1 Analyze how photosynthesis supports energy flow and matter cycling in ecosystems using chemical representations.

Example: Students are provided with the chemical equation for photosynthesis (C6O_2 + 6H_2 O+light energy→ C_6 H_12 O_6+ 6O_2) and a diagram of a freshwater pond ecosystem containing algae, aquatic plants, zooplankton, fish, and decomposers. The equation shows carbon dioxide and water, with light energy, being transformed into glucose and oxygen. The ecosystem diagram shows aquatic plants and algae as producers and arrows showing energy and matter moving from producers to consumers and

decomposers. Students use the chemical representation and ecosystem model to explain how photosynthesis transforms matter and energy and makes chemical energy stored in plant material available to other organisms.

Student Task(s) –

Analyze the chemical equation to identify the reactants and products of photosynthesis.

Explain how matter is transformed during the process.

Use the chemical equation and ecosystem diagram to explain how photosynthesis contributes to energy flow and matter cycling among organisms in the pond ecosystem.

Benchmark Clarifications:

Clarification 1: Instruction includes the chemical equation for photosynthesis and identifying the reactants (carbon dioxide and water) and products (glucose and oxygen), as well as the role of light energy, and explaining how photosynthesis transforms energy and matter to support ecosystem processes.

Clarification 2: Instruction includes connecting photosynthesis and cellular respiration as complementary processes that support energy flow and matter cycling in ecosystems.

Clarification 3: Instruction includes identifying patterns and relationships among reactants, products, energy flow, and matter cycling in ecosystems. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using chemical equations, diagrams, and system models to represent how photosynthesis transforms energy and matter and contributes to ecosystem processes. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analyzing data, investigations, diagrams, or observations, such as data showing changes in oxygen production or carbon dioxide concentration, to explain how photosynthesis supports energy flow and matter cycling in ecosystems. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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SC.8.P.1.2 Analyze how environmental factors affect the rate of photosynthesis and influence plant growth and ecosystems.

Benchmark Clarifications:

Clarification 1: Instruction includes environmental factors such as light intensity, temperature, and carbon dioxide concentration that affect the rate of photosynthesis and that limiting factors can restrict the rate of photosynthesis.

Clarification 2: Instruction includes explaining cause-and-effect relationships between environmental conditions, photosynthesis rate, plant growth, and ecosystem processes.

Clarification 3: Instruction is limited to a conceptual and data-based understanding of photosynthesis rate and excludes detailed biochemical mechanisms.

Clarification 4: Instruction includes interpreting data, graphs, experimental results, and other evidence to identify patterns and relationships showing how environmental factors influence photosynthesis rate and predicting how changes in environmental conditions affect photosynthesis, plant growth, and ecosystem processes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using and evaluating models such as graphs, diagrams, or simulations to represent how environmental factors influence photosynthesis rate and related ecosystem outcomes. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analyzing experimental data or investigations, such as changes in oxygen production under different conditions, to determine how environmental factors affect the rate of photosynthesis. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.P.2 Explain how plant variation and adaptations influence survival and reproduction in changing environments.

SC.8.P.2.1 Explain how plant adaptations and variation influence survival and reproduction in changing environments.

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Example: Students investigate a population of sunflower plants exposed to limited water. The population includes individual plants with naturally occurring differences in leaf size. Students are provided with data showing the average leaf area, percentage of plants surviving, and average number of seeds produced for plants with smaller, medium, and larger leaves after four weeks of reduced water availability.

Average Leaf Area	Plants Surviving (%)	Average Seeds Produced per Plant
80 cm^2	88	42
120 cm^2	72	31
160 cm^2	51	19

Students use the data to examine how variation in leaf size is associated with survival and reproduction when water availability is limited.

Student Task(s) –

Analyze the data to identify patterns in survival and seed production among sunflower plants with different leaf sizes when water availability is limited.

Use evidence from the data to explain how variation in leaf size may influence the ability of individual plants to survive and reproduce under changing environmental conditions.

Benchmark Clarifications:

Clarification 1: Instruction includes structural and functional adaptations and variation within plant populations, where differences in traits may influence a plant's ability to survive and reproduce in specific and changing environments.

Clarification 2: Instruction is limited to a conceptual understanding of plant adaptations and variation and excludes detailed genetic mechanisms.

Clarification 3: Instruction includes identifying patterns in how variation within plant populations relates to differences in survival and reproduction. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as diagrams or representations to illustrate how variation and adaptations influence plant survival and reproduction in

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changing environments. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analyzing data, observations, or scenarios to explain how plant traits influence survival and reproduction under different environmental conditions. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

The Science of Animals

How animal cells, body systems, and behaviors support survival, reproduction, and movement, and how animals interact with ecosystems to drive energy flow, matter cycling, and biodiversity.

Grade 6

SC.6.A.1 Explain how animals use specialized structures and interact with their environment to obtain energy and resources needed for survival.

SC.6.A.1.1 Recognize that animals are multicellular organisms with specialized structures that support survival.

Example: Students examine images and short descriptions of three animals found in Florida: a Florida manatee, a brown pelican, and a gopher tortoise. Each set of information identifies several observable structures, including the manatee's paddle-like flippers and broad tail, the brown pelican's long bill and expandable throat pouch, and the gopher tortoise's strong, shovel-like front legs and shell. Students identify additional specialized structures and connect each structure to the survival function it supports.

Student Task(s) –

Identify the specialized structures shown for each Florida animal and describe the function of each structure.

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Explain how each specialized structure helps the animal obtain food, move, or obtain protection needed for survival.

Benchmark Clarifications:

Clarification 1: Instruction includes that animals have specialized structures that support survival functions such as obtaining food, movement, and protection.

Clarification 2: Instruction is limited to general structure-function relationships and excludes detailed study of organ systems or cellular specialization.

Clarification 3: Instruction includes identifying patterns in how structures support similar survival functions across animals. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as diagrams or representations to identify animal structures and their functions. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.6.A.1.2 Explain that animals interact with their environment to obtain energy and resources for survival.

Example: Students examine a scenario involving a Florida black bear living in a forested area of central Florida. They are provided with a map of the bear's habitat showing areas of forest, freshwater ponds, and developed land, along with information about the availability of berries, insects, small animals, and water in different areas. The scenario also identifies seasonal changes in food and water availability. Students use the information to determine how the bear interacts with its environment to obtain the resources it needs to survive.

Student Task(s) –

Identify the biotic and abiotic resources the Florida black bear obtains from its environment.

Explain how the bear’s interactions with its environment help it obtain the resources needed for survival.

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Benchmark Clarifications:

Clarification 1: Instruction includes that animals obtain energy by consuming other organisms.

Clarification 2: Instruction includes interactions with biotic and abiotic factors to obtain resources such as food, water, oxygen, shelter, and space.

Clarification 3: Instruction includes cause-and-effect relationships between interactions and survival.

Clarification 4: Instruction includes identifying patterns in how access to resources influences survival. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as diagrams to represent interactions between animals and their environment. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data or scenarios to explain how interactions affect survival. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Grade 7

SC.7.A.1 Explain how animal body systems and behaviors support survival, movement, and reproduction in changing environments.

SC.7.A.1.1 Explain how animal body systems support survival, movement, and response to the environment.

Example: Students examine a scenario involving a loggerhead sea turtle swimming toward the surface after remaining underwater to search for food. They are provided with a simplified diagram of the turtle's respiratory, circulatory, muscular, and nervous systems

and observations of its breathing rate before and after returning to the surface. Students use the diagram and observations to determine how the body systems work together as the turtle moves and responds to changing conditions in its environment.

Student Task(s) –

Use the system diagram and observations to explain how the turtle's respiratory, circulatory, muscular, and nervous systems work together as it moves and responds to changes in its environment.

Explain how the interactions of these body systems support the turtle's survival.

Benchmark Clarifications:

Clarification 1: Instruction includes that body systems perform functions such as obtaining energy, transporting materials, exchanging gases, and responding to stimuli.

Clarification 2: Instruction includes that body systems interact to support survival, movement, and stable internal conditions.

Clarification 3: Instruction is limited to conceptual understanding of system functions and interactions and excludes detailed anatomical structures or processes.

Clarification 4: Instruction includes identifying patterns in how systems work together to maintain function. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as system diagrams to represent how body systems interact. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data or observations to explain how body systems support survival. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.A.1.2 Analyze how animal behaviors influence survival and reproduction.

Example: Students examine a scenario involving Florida scrub jays living in an area where food resources and vegetation cover vary among habitat locations. Students are provided

with observations of scrub jay behaviors, including where birds search for food, where they store acorns, and where they build nests, along with data showing the number of offspring successfully fledged in areas with different amounts of food and vegetation cover. Students use the observations and data to determine how the birds' behaviors are related to survival and reproductive success.

Student Task(s) –

Analyze the observations and data to identify relationships between Florida scrub jay behaviors, available resources, and survival or reproductive outcomes.

Use evidence from the observations and data to explain how animal behavior can influence survival and reproductive success.

Benchmark Clarifications:

Clarification 1: Instruction includes behaviors related to obtaining food, avoiding predators, responding to environmental conditions, and reproduction.

Clarification 2: Instruction includes analyzing how behaviors increase the likelihood of survival and reproductive success.

Clarification 3: Instruction includes analyzing scenarios or data to identify relationships between behavior and outcomes.

Clarification 4: Instruction includes identifying patterns and relationships between behaviors and survival or reproductive outcomes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using behavioral models to predict how changes in environmental conditions may influence survival and reproductive success. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data and evidence to explain how behaviors affect survival and reproduction. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Proposed DRAFT Standards

Grade 8

SC.8.A.1 Analyze how animal behaviors, adaptations, and ecological roles support survival, reproduction, and the flow of energy and cycling of matter in ecosystems.

SC.8.A.1.1 Analyze how animal behaviors and adaptations influence survival in changing environments.

Example: Students examine a population of Florida bonneted bats living in an area where changes in vegetation have altered the availability of daytime roosting sites. Students are provided with photographs showing variation in roosting locations used by the bats and data comparing the number of bats surviving in areas with different amounts of suitable roosting habitat before and after the vegetation change. Students analyze the evidence to determine how behavioral and structural characteristics may influence survival when environmental conditions change.

Student Task(s) –

Analyze the photographs and data to identify relationships among the bats' characteristics, environmental conditions, and survival.

Use evidence from the photographs and data to explain how behavioral or structural adaptations may influence survival when the environment changes.

Benchmark Clarifications:

Clarification 1: Instruction includes behavioral and structural adaptations that support survival.

Clarification 2: Instruction includes how variation in traits and behaviors influences survival in changing environments.

Clarification 3: Instruction includes analyzing data or scenarios to identify relationships between adaptations, environmental conditions, and survival.

Clarification 4: Instruction includes identifying patterns in how traits influence survival over time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 5: Instruction includes using data and models to predict how environmental changes may affect the success of different adaptations. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data and evidence to explain how adaptations influence survival. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.A.1.2 Explain how animals contribute to energy flow and matter cycling in ecosystems.

Example: Students examine a food web from a Florida freshwater lake that includes algae, aquatic plants, zooplankton, insects, bluegill fish, largemouth bass, and decomposers. The food web shows feeding relationships among the organisms. Students are also provided with information about carbon dioxide released by organisms during respiration and nutrients returned to the water through waste and decomposition. Students use the food web and information provided to trace how energy and matter move through the ecosystem as animals consume other organisms, respire, and produce waste.

Student Task(s) –

Use the food web to trace how energy is transferred from producers through consumers in the freshwater ecosystem.

Explain how animals contribute to matter cycling through feeding, respiration, and waste production, using evidence from the food web and information provided.

Benchmark Clarifications:

Clarification 1: Instruction includes that animals act as consumers that transfer energy within food webs.

Clarification 2: Instruction includes that animals contribute to the cycling of matter through feeding, respiration, and waste production.

Clarification 3: Instruction includes how interactions among organisms influence energy transfer and matter cycling.

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Clarification 4: Instruction includes explaining how the roles of animals within an ecosystem contribute to energy flow, matter cycling, and the stability of the ecosystem.

Clarification 5: Instruction includes identifying patterns in energy transfer and matter cycling within ecosystems. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as food webs or diagrams to represent energy flow and matter cycling. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of data or scenarios to explain how animals contribute to ecosystem processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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The Science of Human Body

How cells form tissues and systems, how the human body maintains balance, interacts with its environment, and sustains life through integrated biological processes.

Grade 6

SC.6.HB.1 Explain how human body systems are composed of organs that work together to support survival and how systems interact to transport materials throughout the body.

SC.6.HB.1.1 Explain that human body systems are composed of organs that work together to support survival.

Example: Students examine a diagram showing the digestive, circulatory, and respiratory systems. The diagram identifies major organs within each system and illustrates how the systems work together to provide nutrients and oxygen to body cells.

Student Task(s) –

Identify organs within each body system shown.

Explain the primary function of each body system.

Describe how multiple body systems work together to support survival.

Use evidence from the diagram to explain interactions among body systems.

Benchmark Clarifications:

Clarification 1: Instruction includes body systems such as digestive, circulatory, and respiratory limited to a conceptual level.

Clarification 2: Instruction includes that organs perform specific functions within each body system.

Clarification 3: Instruction includes that body systems interact to meet basic needs such as obtaining nutrients and oxygen.

Clarification 4: Instruction includes identifying patterns in how different body systems contribute to similar survival functions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as diagrams or system representations to illustrate how organs and body systems work together. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of observations or simple data to explain how body systems support survival. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.HB.1.2 Explain how the digestive and circulatory systems interact to transport nutrients to cells in the human body.

Example: During a sixth-grade science class, students examine a diagram showing what happens in the body after a student eats a turkey sandwich. The diagram includes the mouth, esophagus, stomach, small intestine, blood vessels, and body cells. Labels identify where food moves through the digestive system and where nutrients enter nearby blood vessels. Students use the diagram to follow the nutrients from the food through the digestive system and into the bloodstream.

Student Task(s) –

Use the diagram to trace the movement of nutrients from the food through the digestive system and into the bloodstream.

Explain how the digestive and circulatory systems work together to transport nutrients to cells in the body.

Benchmark Clarifications:

Clarification 1: Instruction includes that the digestive system breaks down food into nutrients.

Clarification 2: Instruction includes that nutrients are absorbed into the bloodstream and transported to cells by the circulatory system.

Clarification 3: Instruction includes explaining the interaction between the digestive and circulatory systems in transporting nutrients.

Clarification 4: Instruction includes connecting nutrient transport to cellular function and survival.

Clarification 5: Instruction includes identifying patterns in how materials are transported within the body to support cellular function. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or system representations to illustrate how the digestive and circulatory systems work together to transport nutrients. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of observations or simple data to explain how nutrients move through body systems to cells. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Grade 7

SC.7.HB.1 Explain how cells, tissues, and organs are organized to support the structure and function of body systems.

SC.7.HB.1.1 Explain how cells form tissues that support the function of human body systems.

Example: During a seventh-grade physical education class, students examine a diagram of the quadriceps muscle as a student runs during a short sprint. The diagram shows individual muscle cells grouped together to form muscle tissue and identifies the quadriceps as part of the muscular system. Students are provided with information about how the muscle tissue changes in length as the leg moves during the sprint. Students use the diagram and information to determine how the organization of muscle cells into tissue supports the function of the muscular system during movement.

Student Task(s) –

Use the diagram to explain how individual muscle cells form muscle tissue in the quadriceps.

Explain how the muscle tissue supports the function of the muscular system during the student's sprint.

Benchmark Clarifications:

Clarification 1: Instruction includes that cells with similar structure and function form tissues.

Clarification 2: Instruction includes that tissues perform specialized functions within body systems.

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Clarification 3: Instruction includes that the coordinated function of tissues supports overall body system function.

Clarification 4: Instruction includes identifying patterns in how different tissues contribute to system functions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as diagrams to represent relationships among cells, tissues, and body systems. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of observations or data to explain how tissues support body system functions. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.HB.2 Explain how human body systems interact to maintain stable internal conditions and support survival.

SC.7.HB.2.1 Explain how human body systems interact to maintain stable internal conditions (homeostasis).

Example: On a hot Florida afternoon, a seventh-grade student walks home from school. Students are provided with a diagram showing the nervous, circulatory, and integumentary systems and a table showing the student's skin temperature, heart rate, and sweating rate at three points during the walk: before leaving school, after 20 minutes outside, and after 15 minutes in an air-conditioned room. Students use the diagram and data to determine how the body responds to the change in environmental temperature and how internal conditions change as the student returns to a cooler environment.

Time	Skin Temperature (°C)	Heart Rate (beats/min)	Sweating Rate (mL/hr)
Before leaving school	33.5	78	0
After 20 minutes outside	35.2	96	18
After 15 minutes in air conditioning	33.8	82	3

Student Task(s) –

Use the diagram and data to describe how the student's body responds to the change in environmental temperature.

Explain how the nervous, circulatory, and integumentary systems interact to help maintain stable internal conditions as the student's environment changes.

Benchmark Clarifications:

Clarification 1: Instruction includes that homeostasis is the maintenance of stable internal conditions in the body.

Clarification 2: Instruction includes that multiple body systems, including the nervous, circulatory, integumentary, and endocrine systems, interact to maintain homeostasis.

Clarification 3: Instruction includes the regulation of nutrients, gases, and waste to maintain internal balance.

Clarification 4: Instruction includes identifying patterns in how the body regulates internal conditions in response to changes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using and evaluating models such as diagrams or system representations to illustrate how nervous, endocrine, and other body systems interact to maintain homeostasis. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of observations or data to explain how body systems maintain stable internal conditions. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.HB.3 Analyze how human body systems perform specific functions to support survival, movement, protection, and reproduction.

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SC.7.HB.3.1 Analyze how the human digestive system obtains and processes nutrients.

Example: After eating a slice of pizza for lunch, a seventh-grade student tracks what happens to the food as it moves through the digestive system. Students are provided with a diagram showing the mouth, esophagus, stomach, small intestine, large intestine, liver, pancreas, and gallbladder and information about the mechanical and chemical processes that occur in each location. The information identifies the nutrients produced as carbohydrates, proteins and fats are broken down and shows where the resulting nutrients are prepared for absorption into the bloodstream. Students analyze the diagram and information to determine how the digestive system processes the food and prepares nutrients for transport to cells.

Student Task(s) –

Analyze the diagram and information to explain how food is mechanically and chemically processed as it moves through the digestive system.

Explain how the digestive system processes carbohydrates, proteins, and fats into nutrients and prepares those nutrients for absorption into the bloodstream.

Benchmark Clarifications:

Clarification 1: Instruction includes major structures of the digestive system: mouth, esophagus, stomach, intestines, liver, pancreas, and gall bladder.

Clarification 2: Instruction includes that food is mechanically and chemically digested into nutrients.

Clarification 3: Instruction includes that food containing proteins, fats (lipids), and carbohydrates is broken down into smaller molecules that can be absorbed as nutrients.

Clarification 4: Instruction includes that nutrients are prepared for absorption into the bloodstream and transport to cells.

Clarification 5: Instruction includes identifying patterns in how food is broken down and nutrients move through the system. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or flow representations to illustrate how the digestive system processes food. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 7: Instruction includes analysis of data, observations, or scenarios to explain how nutrients are processed and prepared for transport. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.HB.3.2 Analyze how the human respiratory system supports gas exchange.

Example: During a seventh-grade science investigation, students examine how breathing changes when a person moves from resting to walking. They are provided with a diagram of the respiratory system showing the nose, trachea, bronchi, and lungs, along with information about oxygen entering the lungs and carbon dioxide leaving the body. Students analyze the diagram and observations from the investigation to determine how the respiratory system supports gas exchange.

Condition	Breathing Rate (breaths/min)	Oxygen in Exhaled Air (%)	Carbon Dioxide in Exhaled Air (%)
Resting	14	16	4
After 5 minutes of walking	22	14	5
After 10 minutes of rest	16	16	4

Student Task(s) –

Analyze the diagram and observations to explain how air moves through the respiratory system during breathing.

Explain how the respiratory system supports the exchange of oxygen and carbon dioxide between the lungs and bloodstream.

Benchmark Clarifications:

Clarification 1: Instruction includes the major structures of the respiratory system: nose, pharynx, larynx, trachea, bronchi, lungs, and diaphragm.

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Clarification 2: Instruction includes that oxygen is taken into the body and carbon dioxide is released.

Clarification 3: Instruction includes that gases are exchanged between the lungs and the bloodstream.

Clarification 4: Instruction includes that oxygen supports cellular processes and carbon dioxide is removed as a waste product.

Clarification 5: Instruction includes identifying patterns in how oxygen and carbon dioxide levels change during respiration. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or system representations to illustrate gas exchange in the respiratory system. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of data or observations to explain how gas exchange supports cellular processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.HB.3.3 Analyze how the human circulatory system transports substances throughout the body.

Example: A seventh-grade student scrapes their knee while playing outside and notices that the area becomes red and warm. Students examine a diagram showing the heart, arteries, veins, capillaries, and blood and are provided with information about substances transported by the blood, including oxygen, nutrients, and carbon dioxide. The diagram shows blood vessels connecting the heart with tissues throughout the body. Students analyze the diagram and information to determine how the circulatory system transports substances to and from cells.

Student Task(s) –

Analyze the diagram to trace how blood moves from the heart through blood vessels to body tissues and back to the heart.

Explain how the circulatory system transports oxygen and nutrients to cells and removes carbon dioxide from cells.

Benchmark Clarifications:

Clarification 1: Instruction includes major components of the circulatory system: heart, arteries, veins, capillaries, and blood.

Clarification 2: Instruction includes that the heart pumps blood throughout the body.

Clarification 3: Instruction includes that the circulatory system transports substances such as oxygen, nutrients, and hormones to cells.

Clarification 4: Instruction includes that the circulatory system removes waste products such as carbon dioxide from cells.

Clarification 5: Instruction includes identifying patterns in how substances move to and from cells within the circulatory system. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or system representations to illustrate how blood moves through the circulatory system and transports substances. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of data or observations to explain how substances are transported throughout the body. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.HB.3.4 Analyze how the human nervous system controls and coordinates body functions.

Example: A seventh-grade student reaches for a cup of hot chocolate and quickly pulls their hand away after touching the hot surface of the cup. Students examine a diagram showing the brain, spinal cord, and nerves and information describing the pathway of signals from the hand to the nervous system and back to the muscles of the arm. Students analyze the diagram and scenario to determine how the nervous system receives information about the hot surface and coordinates the student's response.

Student Task(s) –

Analyze the diagram and scenario to trace how information from the student's hand is transmitted through the nervous system.

Explain how the nervous system receives and processes information about the hot surface and coordinates the student's response.

Benchmark Clarifications:

Clarification 1: Instruction includes major components of the nervous system: brain, spinal cord, and nerves.

Clarification 2: Instruction includes receiving, processing, and responding to stimuli.

Clarification 3: Instruction includes transmitting signals between the brain and the rest of the body.

Clarification 4: Instruction includes coordinating body actions and responses to internal and external conditions.

Clarification 5: Instruction includes identifying patterns in how the body responds to different stimuli. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or system representations to illustrate how signals move through the nervous system to control body functions. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of observations or data to explain how the nervous system responds to stimuli and coordinates body actions. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.HB.3.5 Analyze how the human immune system protects the body from pathogens.

Example: After several students at a middle school are absent with cold symptoms, a seventh-grade science class examines a model of how the body responds when a pathogen enters through the nose or mouth. The model identifies the skin and mucous membranes as protective barriers and shows the lymph nodes, spleen, bone marrow, and thymus as components of the immune system. Students are provided with observations from a simulated infection showing changes in the body before, during, and after the

infection. They analyze the model and observations to determine how different components of the immune system contribute to the body's response to the pathogen.

Student Task(s) –

Analyze the model and observations to identify how the immune system responds when a pathogen enters the body.

Explain how the immune system's response to the pathogen helps protect the body from infection.

Benchmark Clarifications:

Clarification 1: Instruction includes major components of the immune system: skin, lymph nodes, spleen, bone marrow, and thymus.

Clarification 2: Instruction includes that the immune system identifies and responds to pathogens.

Clarification 3: Instruction includes that the immune system helps prevent and fight infections.

Clarification 4: Instruction includes identifying patterns in how the body responds to pathogens and infection. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as diagrams or system representations to illustrate how the immune system detects and responds to pathogens. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data or observations to explain how the immune system responds to infection. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.HB.3.6 Analyze how the human musculoskeletal system supports the body, protects organs, and enables movement.

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Example: A seventh-grade student is learning about the skeletal system after noticing how different parts of the body are shaped and positioned. Students examine a model of the human skeleton that includes the skull, rib cage, vertebral column, pelvis, major bones, joints, muscles, tendons, ligaments, and cartilage. The model also includes images of a person sitting upright, bending an arm, and walking. Students analyze the model and images to determine how different parts of the musculoskeletal system contribute to supporting the body, protecting internal organs, and producing movement.

Student Task(s) –

Analyze the model to identify how different musculoskeletal structures contribute to supporting the body and protecting internal organs.

Explain how the interaction of muscles, bones, and joints enables movement.

Benchmark Clarifications:

Clarification 1: Instruction includes major components of the musculoskeletal system: bones, muscles, joints, tendons, ligaments, and cartilage.

Clarification 2: Instruction includes that the musculoskeletal system provides structure and support for the body.

Clarification 3: Instruction includes that the musculoskeletal system protects internal organs.

Clarification 4: Instruction includes that movement is enabled through the interaction of muscles and bones.

Clarification 5: Instruction includes identifying patterns in how different structures contribute to support, protection, and movement. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or representations to illustrate how bones, muscles, and joints interact to support and move the body. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of observations or data to explain how the musculoskeletal system enables movement and protects the body. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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SC.7.HB.3.7 Analyze how the human excretory system removes waste and maintains internal balance.

Example: During a seventh-grade science investigation, students examine what happens to the body after a student spends several hours at a Florida outdoor festival on a hot afternoon. Students are provided with a diagram of the kidneys, ureters, bladder, urethra, and skin and information about the student's water intake, urine output, and sweating during the afternoon. The information also shows changes in the amount of water and salts lost from the body. Students analyze the diagram and information to determine how the excretory system removes waste and regulates water and salt levels.

Measurement	Before outdoor activity	After 3 hours outdoors
Water consumed	0 mL	750 mL
Urine produced	400 mL	150 mL
Sweat produced	100 mL	900 mL
Salt lost through sweat	0 g	5 g

Student Task(s) –

Analyze the diagram and information to explain how the excretory system removes metabolic waste from the body.

Explain how the excretory system regulates water and salt levels to help maintain homeostasis.

Benchmark Clarifications:

Clarification 1: Instruction includes major components of the excretory system: kidneys, ureters, bladder, urethra, and skin.

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Clarification 2: Instruction includes that the excretory system removes metabolic wastes from the body.

Clarification 3: Instruction includes that the excretory system regulates water and salt balance.

Clarification 4: Instruction includes that waste removal and regulation of fluids support homeostasis.

Clarification 5: Instruction includes identifying patterns in how the body regulates water, salts, and waste to maintain stability. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or system representations to illustrate how the excretory system removes waste and regulates internal balance. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of observations or data to explain how the excretory system removes waste and maintains internal balance. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.HB.3.8 Analyze how the human reproductive system produces offspring.

Example: Students examine a simplified diagram of the human reproductive system that identifies the testes, ovaries, and uterus. The diagram is accompanied by information describing the reproductive cells produced by the testes and ovaries and the role of the uterus in supporting development before birth. Students analyze the diagram and information to determine how the structures of the reproductive system contribute to producing offspring.

Student Task(s) –

Analyze the diagram and information to identify the roles of the testes, ovaries, and uterus in human reproduction.

Explain how the reproductive system produces offspring using evidence from the diagram and information provided.

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Benchmark Clarifications:

Clarification 1: Instruction includes major structures of the reproductive system: testes, ovaries, and uterus.

Clarification 2: Instruction includes that the reproductive system produces specialized reproductive cells.

Clarification 3: Instruction is limited to a conceptual understanding of reproductive processes and excludes detailed anatomical or physiological mechanisms.

Clarification 4: Instruction includes identifying patterns in life cycles and reproduction across organisms. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as diagrams or representations to illustrate the role of reproductive structures in producing offspring. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of observations or scenarios to explain how the reproductive system contributes to producing offspring. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Grade 8

SC.8.HB.1 Analyze how multiple body systems interact to maintain stable internal conditions under changing environmental conditions.

SC.8.HB.1.1 Explain how body systems interact to maintain homeostasis in changing environmental conditions.

Example: During a family camping trip, an eighth-grade student spends several hours hiking on a cool morning and then remains outside as the temperature rises during the afternoon. Students examine a model showing the respiratory, circulatory, nervous, and excretory systems and are provided with data showing the student's body temperature, heart rate, breathing rate, and water loss at several points during the day. Students use the model and data to explain how the body systems respond as environmental conditions change and work together to maintain stable internal conditions.

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Time	Environmental Temperature (°C)	Body Temperature (°C)	Heart Rate (beats/min)	Breathing Rate (breaths/min)
9:00 a.m.	16	36.8	78	15
12:00 p.m.	27	37.1	92	19
3:00 p.m.	31	37.2	98	21
5:00 p.m.	24	37.0	84	17

Student Task(s) –

Use the data to describe how the student's physiological conditions change as the environmental conditions change.

Explain how the respiratory, circulatory, nervous, and excretory systems interact to maintain stable internal conditions in response to changes in the environment.

Benchmark Clarifications:

Clarification 1: Instruction includes interactions among multiple human body systems including circulatory, respiratory, nervous, endocrine, and excretory.

Clarification 2: Instruction includes maintaining stable internal conditions such as temperature, nutrient levels, and waste removal.

Clarification 3: Instruction includes how human body systems respond to environmental changes such as temperature, activity level, and hydration.

Clarification 4: Instruction is limited to a conceptual understanding of positive and negative feedback mechanisms and excludes detailed physiological regulation processes.

Clarification 5: Instruction includes analyzing cause-and-effect relationships between environmental changes and body system responses.

Clarification 6: Instruction includes analyzing trends in physiological data such as temperature, hydration, respiration rate, or heart rate to explain homeostatic responses. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 7: Instruction includes using models such as diagrams or system representations to illustrate how body systems interact to maintain homeostasis. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analysis of data or observations to explain how body systems respond to environmental changes to maintain stability. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.HB.2 Analyze how risk factors and diseases influence human body systems and overall function.

SC.8.HB.2.1 Analyze risk factors and impacts of diseases on human body systems.

Example: Students in an eight-grade science class are examining data from a 10-year health study of adults who reported different dietary patterns. One group regularly consumed meals that included a balanced diet rich in fruits, vegetables, lean protein, and whole grains, while the other group more frequently consumed processed foods high in added sugars and saturated fats. Students compare the incidence of heart disease and Type 2 diabetes between the two groups and analyze the data to determine relationships between the dietary patterns and disease risk.

Data Table:

Group	Diet Type	Heart Disease (%)	Type 2 Diabetes (%)
A	More fruits, vegetables, whole grains, and lean protein	8	6
B	More foods high in added sugars and saturated fats	22	25

Student Task(s) –

Analyze the data to identify patterns in the incidence of heart disease and Type 2 diabetes between the two dietary-pattern groups.

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Use evidence from the data and information about the diseases to explain how a dietary risk factor can influence disease development and impact multiple body systems, such as the circulatory and endocrine systems.

Benchmark Clarifications:

Clarification 1: Instruction includes risk factors such as poor nutrition, physical inactivity, obesity, age, and family history.

Clarification 2: Instruction includes that diseases may affect multiple body systems simultaneously.

Clarification 3: Instruction includes analyzing the impacts of diseases on body systems and overall health.

Clarification 4: Instruction is limited to diseases such as heart disease, Type 2 diabetes, and kidney disease.

Clarification 5: Instruction includes identifying patterns and trends in data related to disease risk, prevalence, and outcomes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or system representations to explain how diseases affect body systems. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of data and evidence to explain how risk factors influence the development and impact of diseases. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.HB.2.2 Explain how healthy lifestyle choices can reduce disease risk and support long-term body system function.

Example: Students examine data comparing physical activity levels, dietary patterns, and health outcomes among groups of individuals. Students analyze patterns in the data and determine how lifestyle choices may influence body system function and disease risk.

Student Task(s) –

Identify patterns between lifestyle factors and health outcomes.

Analyze evidence relating physical activity and nutrition to disease risk.

Explain how healthy choices support body system function.

Use evidence to predict how lifestyle changes may influence long-term health.

Benchmark Clarifications:

Clarification 1: Instruction includes healthy lifestyle factors such as balanced nutrition, physical activity, adequate sleep, hydration, and avoidance of harmful substances.

Clarification 2: Instruction includes that healthy lifestyle choices may reduce risk for chronic diseases.

Clarification 3: Instruction includes that multiple body systems benefit from healthy lifestyle choices.

Clarification 4: Instruction includes identifying patterns and trends in health-related data. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models and data representations to explain relationships among lifestyle factors, disease risk, and body system function. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of health data, investigations, and evidence to explain how lifestyle factors influence long-term health. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

DRAFT

The Science of Nutrition

How food provides chemical energy and materials for the human body; how nutrients and hydration are processed, absorbed, and regulated by cells and body systems; and how interactions between foods, beverages, and biological systems support growth, balance, and ongoing life processes over time.

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Grade 6

SC.6.NT.1 Explain how food is mechanically and chemically digested, how macronutrients and micronutrients are absorbed and transported through body systems, how hydration supports these processes, and how cell membranes regulate the movement of nutrients into and out of cells to support cellular function.

SC.6.NT.1.1 Explain the difference between mechanical and chemical digestion.

Example: During a sixth-grade science investigation, students examine what happens to a piece of cracker, which contains starch. Students first break a cracker into smaller pieces and observe the change in size and shape. They then observe a teacher demonstration in which amylase is added to cracker starch, with an indicator used to show the change in starch as the enzyme acts on it. Students compare the physical change observed when the cracker is broken apart with the chemical change observed when the starch is acted on by the enzyme.

Student Task(s) –

Compare the observations from the two parts of the investigation and explain how the physical breakdown of the cracker differs from the breakdown of starch by amylase.

Explain the difference between mechanical digestion and chemical digestion using evidence from the investigation.

Benchmark Clarifications:

Clarification 1: Instruction includes mechanical digestion as the physical breakdown of food into smaller pieces.

Clarification 2: Instruction includes chemical digestion as the breakdown of food into simpler substances by enzymes.

Clarification 3: Instruction includes that physical and chemical properties of food, including processing, can influence how food is broken down.

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Clarification 4: Instruction includes distinguishing nutrients from other substances in foods, such as preservatives, that may affect food properties or shelf life but do not provide energy or building materials for the body.

Clarification 5: Instruction includes using models such as diagrams or flow representations to compare mechanical and chemical digestion processes. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of observations or simple investigations to distinguish between mechanical and chemical digestion. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.NT.1.2 Describe how nutrients are absorbed and transported in the digestive system.

Example: Before a sixth-grade school field day, a student eats a banana and a granola bar for breakfast. Students examine a diagram showing the path of the food through the stomach and small intestine. The diagram identifies carbohydrates in the foods and shows that, after digestion, nutrients move through the wall of the small intestine into nearby blood vessels. Students use the diagram to trace the movement of nutrients from the digestive system into the bloodstream and describe how the nutrients are then transported to cells throughout the body.

Student Task(s) –

Use the diagram to identify where most nutrient absorption occurs and trace the movement of nutrients from the small intestine into nearby blood vessels.

Describe how absorbed nutrients move from the digestive system into the bloodstream and are transported to cells for growth and energy.

Benchmark Clarifications:

Clarification 1: Instruction includes that nutrient absorption occurs primarily in the small intestine.

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Clarification 2: Instruction includes that nutrients pass from the digestive system into the bloodstream.

Clarification 3: Instruction includes that transported nutrients are delivered to cells for use in growth and energy.

Clarification 4: Instruction is limited to a conceptual understanding of nutrient absorption and excludes detailed molecular processes.

Clarification 5: Instruction includes using models such as diagrams or flow representations to illustrate how nutrients move from the digestive system into the bloodstream. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of observations or simple investigations to explain how nutrients move from the digestive system to the rest of the body. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.NT.1.3 Explain how the cell membrane regulates the movement of nutrients into and out of cells.

Example: During a sixth-grade investigation of plant growth, students examine root cells from bean seedlings grown in two solutions containing different concentrations of dissolved mineral nutrients. Students are provided with a model of a root cell showing the cell membrane and the concentration of nutrients inside and outside the cell. The model represents substances moving across the membrane under different conditions, including movement from an area of higher concentration to an area of lower concentration and movement that requires energy. Students use the model to explain how the cell membrane controls which nutrients and other substances enter and leave the root cell.

Student Task(s) –

Use the model to describe how the concentration of substances inside and outside the bean root cell affects their movement across the cell membrane.

Explain how the cell membrane regulates the movement of nutrients and other substances into and out of the root cell.

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Benchmark Clarifications:

Clarification 1: Instruction includes the cell membrane is a selectively permeable barrier that regulates what enters and leaves the cell.

Clarification 2: Instruction includes processes such as diffusion, osmosis, and active transport at a conceptual level.

Clarification 3: Instruction includes that these processes allow nutrients and other substances to move into and out of cells.

Clarification 4: Instruction is limited to a conceptual understanding of nutrient movement and excludes detailed mechanisms such as adenosine triphosphate (ATP) cycles and membrane protein structures.

Clarification 5: Instruction includes using models such as diagrams or representations to illustrate how the cell membrane controls movement of substances. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.6.NT.1.4 Describe how nutrients are transported through the circulatory system to cells.

Example: During a sixth-grade science investigation, students examine what happens after a student eats a peanut butter and banana sandwich before a school field trip. Students are provided with a diagram showing the small intestine, heart, arteries, veins, and body cells. The diagram shows nutrients entering the bloodstream from the small intestine and blood carrying those nutrients away from the digestive system to tissues throughout the body. Students use the diagram to trace the pathway of nutrients from the digestive system through the circulatory system to cells.

Student Task(s) –

Use the diagram to trace the pathway of nutrients from the small intestine through the bloodstream to cells throughout the body.

Describe how the circulatory system transports nutrients from the digestive system to cells.

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Benchmark Clarifications:

Clarification 1: Instruction includes that blood is the primary transport medium for nutrients.

Clarification 2: Instruction includes that nutrients absorbed in the digestive system enter the bloodstream and are transported to cells.

Clarification 3: Instruction includes the digestive and circulatory systems as interacting components of a system that distributes nutrients throughout the body.

Clarification 4: Instruction includes a basic understanding of circulation and excludes detailed study of heart anatomy beyond its role in moving blood.

Clarification 5: Instruction includes using models such as diagrams or system representations to illustrate how nutrients move from the digestive system through the bloodstream to cells. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of observations or simple data to explain how nutrients are transported through the circulatory system to cells. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.NT.1.5 Explain the roles of macronutrients and micronutrients in digestion and absorption.

Example: A sixth-grade science class compares a granola bar and an orange that a student might pack for a school field trip. Students examine the nutrition information below and a diagram of the digestive system showing where nutrients are broken down and absorbed. They use the information and diagram to explain how macronutrients and micronutrients differ in their roles and how they are processed and absorbed by the body.

Nutrient	Granola Bar	Orange
Carbohydrates	24 g	15 g
Protein	4 g	1 g
Fat	7 g	0 g
Vitamin C	0 mg	70 mg

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Calcium 20 mg 50 mg

Iron 1 mg 0.1 mg

Student Task(s) –

Use the nutrition information and digestive-system diagram to identify the macronutrients and micronutrients provided by each food.

Explain how macronutrients and micronutrients differ in their roles and how the body processes and absorbs them.

Benchmark Clarifications:

Clarification 1: Instruction includes macronutrients (carbohydrates, proteins, and fats) as sources of energy and building materials.

Clarification 2: Instruction includes micronutrients (vitamins and minerals) as substances required in smaller amounts to support body processes.

Clarification 3: Instruction includes connecting nutrient types to how they are broken down and absorbed in the digestive system.

Clarification 4: Instruction includes distinguishing nutrients from other substances found in foods, such as preservatives, which may affect food properties or shelf life but do not serve as sources of energy or building materials.

Clarification 5: Instruction excludes dietary intake recommendations and focuses on nutrient function in digestion and absorption.

Clarification 6: Instruction includes that food composition and level of processing can influence how nutrients are broken down and absorbed in the body.

Clarification 7: Instruction is limited to a general understanding of nutrient roles and excludes detailed biochemical processes, toxicology, and dosage thresholds.

Clarification 8: Instruction includes using models such as diagrams or flow representations to illustrate how different types of nutrients are digested and absorbed. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 9: Instruction includes analysis of observations or simple data to explain how different nutrients are processed and absorbed in the body. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.NT.1.6 Explain how water and other beverages support digestion, absorption, and circulation in the human body.

Example: At a sixth-grade school cafeteria, students examine the labels of four beverages available during lunch: water, 1% milk, 100% orange juice, and regular soda. Students are provided with information about the water, sugar, and nutrient content of each beverage and a diagram showing how beverages move through the digestive system and how substances are absorbed into the bloodstream. Students compare the beverage compositions and use the diagram to explain how water and other substances in the beverages support digestion, absorption, and circulation.

Beverage	Water (mL per 240 mL)	Sugars (g)	Nutrients*
Water 240	0	None	
1% milk	220	12	Protein, calcium, vitamin D
100% orange juice	215	20	Vitamin C, potassium
Regular soda 230	26	None	

*Examples of nutrients present; not a complete nutrition profile.

Student Task(s) –

Compare the water, sugar, and nutrient content of the four beverages using the information provided.

Explain how water and other substances in beverages move through the digestive system, enter the bloodstream, and support processes in the body.

Benchmark Clarifications:

Clarification 1: Instruction includes that water is the primary medium that supports digestion, nutrient transport, and waste removal.

Clarification 2: Instruction includes comparing water, milk, fruit juice, and soda based on water content, sugars, and nutrient content and level of processing, as it relates to how the body absorbs and uses these substances.

Clarification 3: Instruction includes that beverages pass through the digestive system and substances are absorbed into the bloodstream.

Clarification 4: Instruction includes connecting the role of beverages to digestion, absorption, and circulation processes.

Clarification 5: Instruction excludes beverage intake recommendations or calorie targets.

Clarification 6: Instruction includes identifying patterns in beverage composition (water, sugars, nutrients) and how these differences relate to their roles in the body. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes using models such as diagrams or flow representations to illustrate how water and other beverages move through the digestive system and into the bloodstream. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analysis of observations or simple data to explain how beverages support digestion, absorption, and transport in the body. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Grade 7

SC.7.NT.1 Explain how cells transform nutrients into usable energy and materials; how body systems regulate nutrient levels and hydration to maintain homeostasis; and how different types of foods and beverages can influence energy balance, hunger, satiety, and long-term biological changes and outcomes.

SC.7.NT.1.1 Explain how cells use nutrients for energy, growth, and repair.

Example: After a seventh-grade student breaks their arm during a bicycle accident, the bone begins to repair as new bone tissue forms around the injured area. Students examine a model showing nutrients delivered through the bloodstream to cells in the healing bone. The model shows cells using nutrients for energy and as building materials to produce new cellular structures. Students use the model to explain how cells use nutrients to support the repair of damaged tissue.

Student Task(s) –

Use the model to explain how cells in the healing bone use nutrients for energy and to build new cellular materials.

Explain how the use of nutrients by cells supports the repair of damaged tissue.

Benchmark Clarifications:

Clarification 1: Instruction includes metabolism as the set of chemical processes that occur within cells to support life.

Clarification 2: Instruction includes that nutrients are used by cells to release energy and to build and repair cellular structures.

Clarification 3: Instruction includes connecting nutrient use to cellular functions such as energy production, growth, and repair.

Clarification 4: Instruction is limited to a conceptual understanding of metabolism and excludes specific metabolic pathways such as the Krebs cycle.

Clarification 5: Instruction includes using models such as diagrams or flow representations to illustrate how nutrients are used by cells for energy, growth, and repair. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of observations or data to explain how cells use nutrients to support life processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.NT.1.2 Explain how energy from food is transformed and used by cells.

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Example: A seventh-grade student stays after school to work on a robotics project and spends several hours building and testing a small robot. Before beginning, the student eats a snack containing carbohydrates. Students examine a model showing chemical energy stored in food being transformed into usable energy by cells and then used for cellular activities. Students use the model to explain how energy from the food supports the student's cells as they carry out the processes needed for movement and other life functions.

Student Task(s) –

Use the model to trace how chemical energy stored in food is transformed into usable energy in cells.

Explain how cells use energy from food to carry out activities such as movement, growth, and repair.

Benchmark Clarifications:

Clarification 1: Instruction includes that chemical energy stored in food is transformed into usable energy for cellular processes.

Clarification 2: Instruction includes that cells use energy to carry out activities such as movement, growth, and repair.

Clarification 3: Instruction is limited to a conceptual understanding of energy transformation and excludes detailed study of molecular energy carriers such as adenosine triphosphate (ATP).

Clarification 4: Instruction includes connecting the role of energy from food to supporting overall cellular function and organism survival.

Clarification 5: Instruction includes using models such as diagrams or flow representations to illustrate how energy from food is transformed and used by cells. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of observations or data to explain how cells use energy to carry out life processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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SC.7.NT.1.3 Explain how body systems interact to regulate nutrient levels.

Example: A seventh-grade student eats breakfast before school and has a bowl of oatmeal with a banana. Students examine a model showing the digestive, circulatory, and endocrine systems and a graph showing the student's blood glucose level before eating, shortly after breakfast, and later in the morning. The model shows nutrients entering the bloodstream after digestion and identifies signals that help regulate the amount of glucose remaining in the blood. Students use the model and graph to explain how the digestive, circulatory, and endocrine systems interact to regulate glucose levels.

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Student Task(s) –

Use the graph to describe the pattern in the student's blood glucose level after eating breakfast.

Explain how the digestive, circulatory, and endocrine systems interact to regulate the glucose level in the bloodstream.

Benchmark Clarifications:

Clarification 1: Instruction includes interactions among the digestive, circulatory, and endocrine systems as components of a regulatory system.

Clarification 2: Instruction includes feedback as a mechanism that helps regulate and maintain stable nutrient levels.

Clarification 3: Instruction is limited to a conceptual understanding of regulatory processes and excludes detailed hormone pathways or mechanisms.

Clarification 4: Instruction includes identifying patterns in how nutrient levels change and are regulated under different conditions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as diagrams or system representations to illustrate how body systems interact to regulate nutrient levels. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.7.NT.1.4 Explain how homeostasis maintains stable internal conditions related to nutrition.

Example: During a seventh-grade science investigation, students examine a scenario involving a student who has not eaten since breakfast. The student becomes hungry before lunch, eats a meal, and later returns to normal activities. Students are provided with a model showing how the body's nutrient levels change as nutrients are used by cells between meals and increase after eating. The model also shows how the body responds to these changes to keep nutrient levels within a stable range. Students use the model to explain how the body maintains stable internal conditions related to nutrition.

Student Task(s) –

Use the model to describe how nutrient levels change when nutrients are used by cells between meals and after the student eats.

Explain how the body's responses to these changes help maintain stable internal conditions.

Benchmark Clarifications:

Clarification 1: Instruction includes that homeostasis is the process of maintaining stable internal conditions in the body.

Clarification 2: Instruction includes maintaining balance of water and nutrient levels through interactions among body system components and feedback mechanisms.

Clarification 3: Instruction includes general examples of how the body regulates conditions related to nutrition, such as hydration and nutrient levels.

Clarification 4: Instruction is limited to a conceptual understanding of homeostasis and excludes detailed physiological or biochemical mechanisms.

Clarification 5: Instruction includes identifying patterns in how nutrient and water levels change and are regulated within the body. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or system representations to illustrate how the body maintains stable internal conditions related to nutrition. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.7.NT.1.5 Explain how different types of foods can influence hunger, satiety, and energy regulation in the body.

Example: Case Study – Two middle school students, Natalie and Suzanne, eat different breakfasts before school. Natalie eats a bowl of oatmeal topped with strawberries and a glass of milk. Suzanne eats a bowl of frosted cereal with a flavored fruit drink. They look at nutrition labels to collect data about their foods' carbohydrate, protein, fat, and fiber content.

Nutrient Information

Breakfast	Carbohydrates	Protein	Fat	Fiber
Oatmeal, strawberries, and milk	48 g	14 g	6 g	8 g
Frosted cereal and flavored fruit drink	57 g	4 g	2 g	2 g

They record their hunger levels throughout the morning. Both students track how they feel in terms of hunger, energy levels, and focus during class. Natalie reports feeling full longer

and having steady energy, while Suzanne feels hungry again quickly and experiences a drop in energy before lunch.

Student Task(s) –

Analyze the nutrient information and student-reported data to identify patterns in how whole foods and highly processed foods influence hunger, satiety, and energy levels over time.

Use scientific reasoning to explain how differences in the foods eaten at breakfast may contribute to digestion, nutrient use, and the students' feelings of fullness, energy, and cravings between the two meals.

Benchmark Clarifications:

Clarification 1: Instruction includes satiety as the feeling of fullness after eating.

Clarification 2: Instruction includes differences between whole foods and highly processed foods in terms of composition, digestion, and how effectively the body can use nutrients.

Clarification 3: Instruction includes conceptual relationships between food types and effects on hunger, satiety, energy levels, and cravings.

Clarification 4: Instruction includes that food processing can influence how body systems regulate energy and nutrients over time.

Clarification 5: Instruction includes that the level of food processing can influence how efficiently the body regulates energy, hunger, and satiety.

Clarification 6: Instruction excludes calorie counting, dietary prescriptions, and disease-focused outcomes.

Clarification 7: Instruction includes identifying patterns and trends in how different foods influence hunger, fullness, and energy over time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes using models such as diagrams to represent how different foods are digested and how they influence energy regulation in the body. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 9: Instruction includes analysis of data or scenarios to explain how different types of foods affect hunger, satiety, and energy regulation. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.NT.1.6 Explain how different beverages influence hydration, energy regulation, hunger, and satiety.

Example: During a seventh-grade after-school basketball practice, a student drinks different beverages during separate practice sessions. For each session, the student drinks water, a sports drink, or a sugar-sweetened fruit drink. Students are provided with the beverage information and the student's recorded thirst, hunger, and perceived energy before practice, immediately after practice, and one hour later. Students examine the data to identify relationships between the beverage consumed and changes in hydration, hunger, and energy over time.

Beverage Information

Beverage	Water (mL/500 mL)	Added Sugar (g/500 mL)	Electrolytes
Water	500	0	None
Sports drink	485	21	Sodium, potassium
Sugar-sweetened fruit drink	470	31	Small amounts of sodium, potassium

Observations: Thirst decreased after all three beverages, with the lowest thirst reported one hour after drinking water. Energy increased immediately after sports drink and fruit drink but later decreased. Hunger increased over time, with the greatest increase after fruit drink.

Student Task(s) –

Analyze the beverage information and observations to identify patterns in hydration, hunger, satiety, and energy levels following consumption of different beverages.

Explain how differences in beverage consumption may influence hydration, energy, regulation, hunger, and satiety over time.

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Benchmark Clarifications:

Clarification 1: Instruction includes hydration as a factor in maintaining homeostasis and supporting body function.

Clarification 2: Instruction includes comparing beverages such as water, milk, fruit juice, and soda based on water content, sugar content, nutrient content, and hydration effectiveness.

Clarification 3: Instruction includes conceptual effects of sugar-sweetened beverages on hydration, energy levels, hunger, and satiety.

Clarification 4: Instruction includes connecting beverage composition to how the body regulates energy and fluid balance.

Clarification 5: Instruction includes that processing and added ingredients in beverages can influence how the body uses water, energy, and nutrients.

Clarification 6: Instruction excludes beverage intake targets, moderation rules, and consumption prescriptions.

Clarification 7: Instruction includes identifying patterns and relationships in how beverage composition affects hydration and energy levels over time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes using models such as diagrams or representations to illustrate how beverages move through the body and influence hydration and energy regulation. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 9: Instruction includes analysis of data or scenarios to explain how different beverages influence hydration, energy regulation, hunger, and satiety. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.NT.1.7 Explain how frequent consumption of highly processed foods can affect body systems and long-term regulation of energy.

Example: Over four weeks, a seventh-grade student frequently chooses packaged pastries, chips, and packaged snack cakes for breakfast and after-school snacks. The student's recorded observations show increasing hunger between meals and less consistent energy

during the school day over the four weeks. Students examine a model showing how repeated differences in food composition can affect the body's regulation of energy and nutrient use over time. Students use the observations and model to explain how frequent consumption of highly processed foods may affect energy regulation and body-system function.

Student Task(s) –

Analyze the observations to identify patterns in the student's hunger and energy levels over the four-week period.

Explain how frequent consumption of highly processed foods may affect the body's regulation of energy and nutrient use over time.

Benchmark Clarifications:

Clarification 1: Instruction includes how frequent consumption of highly processed foods can influence how effectively body systems regulate energy and nutrients over time.

Clarification 2: Instruction includes that whole foods provide nutrients that support normal body function and long-term wellness.

Clarification 3: Instruction includes that differences in food quality may influence how efficiently the body uses nutrients to maintain normal function.

Clarification 4: Instruction includes conceptual descriptions of how highly processed foods may affect energy balance, hunger, and system regulation over time.

Clarification 5: Instruction is limited to general, non-clinical and excludes detailed disease mechanisms or medical conditions.

Clarification 6: Instruction includes identifying patterns and trends in how consumption of different types of foods relates to energy levels, hunger, and system regulation over time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes using models such as diagrams or flow representations to illustrate how frequent consumption of highly processed foods may affect body systems over time. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

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Grade 8

SC.8.NT.1 Explain how nutrition and hydration support multiple body systems over time; explain how long-term patterns of nutrient and beverage intake influence growth and function across the lifespan; and analyze how environmental, societal, and informational factors shape human nutrition using evidence-based reasoning.

SC.8.NT.1.1 Explain how nutrients and food composition support multiple body systems over time.

Example: An eighth-grade science class examines how nutrition supports a student's participation in school marching band over an entire semester. Students are provided with information about the student's intake of foods containing calcium, protein, iron and vitamin C, and a model showing how these nutrients support the skeletal, muscular, nervous, and immune systems. Students examine the information to explain how nutrients support the structure and function of multiple body systems over time.

Time	Calcium (mg/day)	Protein (g/day)	Iron (mg/day)	Vitamin C (mg/day)	Rehearsal Energy Rating*
September	850	52	12	65	3
November	780	50	10	58	3
January	690	47	8	48	2

1 = very low energy, 5 = very high energy.

Student Task(s) –

Analyze the data to identify patterns in nutrient intake and the student's reported energy during the semester.

Use the data and model to explain how nutrients support the skeletal, muscular, nervous, and immune systems over time.

Benchmark Clarifications:

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Clarification 1: Instruction includes connections between nutrition and multiple body systems, including the muscular, skeletal, nervous, and immune systems.

Clarification 2: Instruction includes the long-term effects of nutrient deficiencies and excesses on body systems.

Clarification 3: Instruction includes connections between nutrition patterns and their effects on cells, tissues, and body systems over time.

Clarification 4: Instruction includes that differences in food composition and level of processing can influence how efficiently nutrients are digested, absorbed, and used by body systems over time.

Clarification 5: Instruction is limited to general, non-clinical explanations of how nutrients and food consumption support body systems.

Clarification 6: Instruction includes identifying patterns and trends in how nutrition and food composition relate to changes in body system function over time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes using models such as diagrams or system representations to illustrate how nutrients and food composition influence body systems. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.8.NT.1.2 Explain how nutrition patterns and food composition can affect human health over a lifespan.

Example: Case Study - An eighth-grade science class examines a 30-year health study that followed adults who reported different dietary patterns beginning in early adulthood. One group more frequently consumed meals containing vegetables, fruits, whole grains, and legumes, while the other group more frequently consumed highly processed foods and sugar-sweetened beverages. Students examine the reported dietary patterns and health measures collected at ages 25, 40, and 55. They use the data and a model showing how nutrition patterns can affect body systems over time to explain relationships between long-term nutrition patterns and changes in health.

Age	Dietary Pattern	Cardiovascular Health Index*	Bone Density Index*
25	More whole foods	94	96

40	More whole foods	89	91
55	More whole foods	83	84
25	More highly processed foods	93	95
40	More highly processed foods	81	86
55	More highly processed foods	70	75

Index values are simulated instructional data representing relative measurements; higher values indicate greater measured function.

Student Task(s) –

Analyze the data to identify patterns in the health measures of the two groups from age 25 through age 55.

Explain how differences in long-term nutrition patterns may be related to changes in body systems and overall health across the lifespan.

Benchmark Clarifications:

Clarification 1: Instruction includes the cumulative effects of nutrition patterns on the body over time.

Clarification 2: Instruction includes both positive and negative health outcomes associated with different nutrition patterns.

Clarification 3: Instruction includes that differences in food composition and level of processing can influence how nutrients are digested, absorbed, and used by the body over time.

Clarification 4: Instruction includes connections between long-term nutrition patterns and changes in body systems and overall health.

Clarification 5: Instruction is limited to general, non-clinical explanations of how nutrition patterns influence health and excludes dietary prescriptions or intake targets.

Clarification 6: Instruction includes identifying patterns and trends in how nutrition patterns relate to changes in health outcomes across time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 7: Instruction includes using models such as diagrams or system representations to illustrate how nutrition patterns influence body systems and health over time. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.8.NT.1.3 Analyze how hydration and beverage composition affect body systems and long-term biological function.

Example: An eighth-grade student participates in the school's cross-country season from August through October. Across the season, the student records the beverages consumed during and after practices. Students examine the student's beverage patterns and data collected during the season. The data include urine specific gravity, a measure used to indicate how concentrated urine is; higher values indicate more concentrated urine and lower values indicate more dilute urine. Students analyze the data to identify relationships between beverage composition, hydration, and changes in body-system function over time.

Beverage Pattern	Urine Specific Gravity (g/mL)	Resting Heart Rate (beats/min)	Energy Rating*
Mostly water	1.015	68	4
Water and sports drink	1.020	70	4
Mostly sugar-sweetened drinks	1.030	75	3

1 = low energy; 5 = high energy.

Student Task(s) –

Analyze the data to identify relationships between beverage patterns, hydration and the student's resting heart rate and energy level.

Explain how beverage composition and hydration may influence body-system function over time.

Benchmark Clarifications:

Clarification 1: Instruction includes how water supports body functions such as circulation, temperature regulation, and cellular processes.

Clarification 2: Instruction includes analysis of beverages such as milk, fruit juice, and soda based on hydration effectiveness, nutrient content, sugar content, and level of processing.

Clarification 3: Instruction includes that beverage composition and level of processing can influence how effectively the body regulates hydration, energy, and nutrient use over time.

Clarification 4: Instruction includes analyzing how beverage consumption patterns affect multiple body systems and overall function over time.

Clarification 5: Instruction is limited to general, non-clinical explanations and excludes beverage intake targets, calorie tracking, or dietary prescriptions.

Clarification 6: Instruction includes identifying patterns and trends in how beverage composition relates to hydration, energy levels, and system function over time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes using models such as diagrams or system representations to illustrate how beverages move through the body and influence hydration and biological function. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

SC.8.NT.1.4 Analyze how environmental and societal factors influence nutrition patterns and food composition.

Example: Case Study – An eighth-grade science class examines food availability in two Florida communities. One community has several full-service grocery stores and farmers' markets within a short distance of residential neighborhoods, while the other has fewer grocery stores and more convenience stores. Students examine a map showing the locations of food retailers and a data table comparing the types of foods commonly available at those locations.

Food Type Community A:

Grocery Stores Community A: Convenience Stores Community B:

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	Grocery Stores		Community B: Convenience Stores	
Fresh fruits and vegetables	18	3	9	2
Whole-grain foods	12	2	6	1
Fresh meats/protein foods	15	2	7	2
Packaged snack foods	8	14	6	18
Sugar-sweetened beverages	6	16	5	20

Values represent the number of sampled food products in each category available at the locations examined.

Student Task(s) –

Analyze the map and data to identify patterns in food availability and food composition between the two communities.

Explain how differences in food availability may influence nutrition patterns and the types of foods available to residents.

Benchmark Clarifications:

Clarification 1: Instruction includes that environmental and societal factors can influence the availability of whole foods and highly processed foods, which affects food composition.

Clarification 2: Instruction includes analyzing how differences in food composition and processing may influence how nutrients are used by the body over time.

Clarification 3: Instruction is limited to descriptive and evidence-based analysis of environmental and societal influences and excludes policy advocacy or prescriptive solutions.

Clarification 4: Instruction includes identifying patterns and trends in how environmental and societal factors relate to differences in nutrition patterns and food composition. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as diagrams or systems representations to illustrate how environmental, societal, and biological factors interact to influence nutrition. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

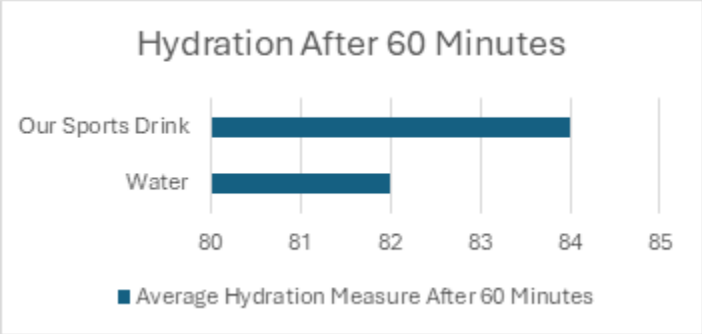
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Clarification 6: Instruction includes analysis of data or scenarios to explain how environmental and societal factors influence food availability, composition, and nutrition patterns. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.NT.1.5Evaluate nutrition information using evidence-based reasoning.

Example: An eighth-grade student sees a social media post claiming that, “Sports drinks hydrate athletes better than water because the added sugar and electrolytes help the body absorb more water.” The post links to a graph showing hydration measurements for people who drank either water or a sports drink after exercise. The graph was included in a social media post created by the beverage company to promote its sports drink. Students examine the claim, graph, and information about the source of the data. They evaluate whether the evidence supports the claim.



“Our Sports Drink provided the highest hydration measure.”

Student Task(s) –

Evaluate whether the evidence provided supports the claim that sports drinks hydrate athletes better than water.

Use the graph and source information to explain the strengths and limitations of the evidence supporting the claim.

Benchmark Clarifications:

Clarification 1: Instruction includes distinguishing scientific evidence from opinions, advertisements, or unsupported claims.

Clarification 2: Instruction includes identifying credible and reliable sources of nutrition information.

Clarification 3: Instruction includes evaluating claims about food composition, nutrient quality, and level of processing using scientific evidence.

Clarification 4: Instruction includes using evidence to evaluate how information relates to body systems, nutrient use, and long-term health.

Clarification 5: Instruction excludes clinical or professional nutrition recommendations and focuses on evaluating information using scientific reasoning.

Clarification 6: Instruction includes analyzing data, graphs, or trends used in nutrition claims to determine their accuracy and validity. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of claims, data, or sources to determine whether nutrition information is supported by evidence. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.NT.1.6 Analyze nutrition information on food labels to compare foods based on nutrient content and composition.

Example: An eighth-grade student is helping prepare snacks for a school movie night. The class examines the Nutrition Facts labels and ingredient lists for a microwave popcorn labeled “Butter Flavor” and a plain popcorn labeled “Sea Salt.” The packages have different serving sizes and different amounts of fat, sodium, and added ingredients. Students analyze the labels to compare the foods based on nutrient content, serving size and the types and level of processing of their ingredients.

Student Task(s) –

Calculate and compare the amounts of fat, sodium, and added sugars provided by one serving of each popcorn using the serving-size information on the labels.

Analyze the ingredient lists to identify differences in added ingredients and level of processing.

Use evidence from the Nutrition Facts labels and ingredient lists to explain how the two foods differ in nutrient content and composition.

Benchmark Clarifications:

Clarification 1: Instruction includes reading ingredient lists and Nutrition Facts labels to identify nutrient content and food components.

Clarification 2: Instruction includes analyzing ingredient lists to identify level of processing and types of added ingredients.

Clarification 3: Instruction includes comparing foods based on both nutrient content and differences in composition, including whole and highly processed ingredients.

Clarification 4: Instruction includes connecting label information to how nutrients and food composition may influence how the body uses food.

Clarification 5: Instruction excludes dietary prescriptions, calorie tracking requirements, or recommendations about food choices.

Clarification 6: Instruction includes calculating and comparing nutrient amounts using serving size and identifying patterns across different foods. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of real or simulated food labels to compare nutrient content and composition using evidence-based reasoning. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.NT.1.7 Analyze how food preparation, cost, and food composition influence nutritional value.

Example: An eighth-grade student is helping prepare a family dinner and compares two ways to make chicken-and-rice bowls: preparing them at home using rice, fresh chicken, frozen vegetables, and seasonings or purchasing a prepackaged chicken-and-rice meal. Students examine the ingredient lists, Nutrition Facts information, preparation methods,

and prices for the two options. They analyze how differences in preparation, cost, and food composition influence the nutritional value of each option.

	Home-Prepared Bowl	Prepackaged Meal
Cost per serving	$2.85	$3.49
Serving size	350 g	350 g
Protein	31 g	18 g
Fiber	5 g	2 g
Sodium	480 mg	890 mg
Added sugars	2 g	5 g
Preparation	Cook chicken and rice; add frozen vegetables and seasonings. Heat in microwave	

Student Task(s) –

Calculate and compare the cost per serving and nutrient amounts for the two meal options.

Analyze how the preparation method and ingredient composition differ between the two options.

Use evidence from the cost, preparation, and nutrition information to explain the trade-offs among cost, preparation, and nutritional value.

Benchmark Clarifications:

Clarification 1: Instruction includes comparing home-prepared foods and prepackaged foods.

Clarification 2: Instruction includes analyzing how preparation method, ingredient composition, and level of processing influence nutritional value.

Clarification 3: Instruction includes that differences in food composition and processing can influence how effectively nutrients are used by the body.

Clarification 4: Instruction includes analyzing trade-offs among cost, preparation, and nutritional value using evidence.

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Clarification 5: Instruction excludes detailed budgeting beyond simple comparisons of food options and packaging.

Clarification 6: Instruction excludes prescriptive judgments about food choices and focuses on analysis of evidence and relationships.

Clarification 7: Instruction includes calculating and comparing costs, serving sizes, and nutrient quantities across food options. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes using models such as charts or diagrams to represent relationships among cost, preparation, composition, and nutritional value. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 9: Instruction includes analysis of real or simulated food data (labels, ingredients, cost) to explain how preparation, composition, and cost influence nutritional value. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

The Science of Fungi

How fungal cells build and support whole organisms, obtain and recycle energy and matter, grow and reproduce, interact with their environments, and shape the ecosystems on which life depends.

Grade 6

SC.6.FG.1 Explain how fungi obtain nutrients and contribute to the cycling of matter in ecosystems.

SC.6.FG.1.1 Recognize that fungi obtain nutrients by absorbing material from their environment.

Example: Students are provided with images and descriptions of oyster mushrooms growing on a fallen oak log in a North Florida forest. The photographs show the fungal structures spreading across the surface of the decaying wood over time, while the accompanying information explains that fungi absorb dissolved nutrients from the organic

material surrounding them and describes how the log breaks down in the forest environment.

Student Task(s) –

Use the images and descriptions to explain how the oyster mushrooms obtain nutrients from the fallen oak log without consuming food as animals do.

Compare how the mushrooms obtain nutrients with how an animal in the forest obtains nutrients, using evidence from the scenario.

Benchmark Clarifications:

Clarification 1: Instruction includes that fungi absorb nutrients from their surroundings rather than ingesting food.

Clarification 2: Instruction includes that fungi obtain nutrients from organic material in their environment, including decaying matter.

Clarification 3: Instruction is limited to a conceptual understanding of nutrient absorption and excludes cellular or biochemical mechanisms.

Clarification 4: Instruction includes identifying patterns in how fungi spread across and break down organic material over time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as diagrams or visual representations to show how fungi obtain nutrients from their environment. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of observations, images, or scenarios to explain how fungi obtain nutrients. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes recognizing changes over time as fungi obtain nutrients and break down organic material. Refer to Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

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SC.6.FG.1.2 Explain how fungi break down organic material, including dead organisms, and recycle matter in ecosystems.

Example: Case Study – After a hurricane passes through a North Florida coastal forest ecosystem, fallen pine trees, pine needles, and branches accumulate on the forest floor. Over several months, students examine photographs and observe white fungal growth appearing on the plant material as the needles and branches become darker, softer, and increasingly broken apart. Insects, small animals, and plants begin to appear around the decaying logs, needles, and branches. Eventually, the pine material breaks down into soil. The accompanying information explains that fungi are growing on the dead wood and breaking it down, releasing matter into the surrounding soil, where it becomes available to plants and other organisms.

Student Task (s) –

Use evidence from the case study to explain how fungi break down the fallen plant material and return matter to the environment.

In response:

Describe how fungi act as decomposers.

Identify what happens to the pine materials on the forest floor over time.

Explain how the broken-down matter supports other organisms in the ecosystem.

Analyze the case study to identify patterns in how the plant material changes over time.

In response:

Describe the changes observed in the pine material from when it first falls to when it becomes part of the soil.

Explain how fungi contribute to these changes.

Use evidence to explain how this process supports the recycling of matter in the ecosystem.

Benchmark Clarifications:

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Clarification 1: Instruction includes that fungi act as decomposers that break down dead plants, animals, and organic materials.

Clarification 2: Instruction includes that decomposition by fungi returns matter to the environment.

Clarification 3: Instruction includes that recycled matter can be used by other organisms to support life processes.

Clarification 4: Instruction includes that fungi contribute to ecosystem processes through the recycling of matter.

Clarification 5: Instruction includes identifying patterns in how matter is broken down and reused within ecosystems. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams to represent how fungi break down materials and recycle matter within ecosystems. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of observations, images, or scenarios to explain how fungi contribute to decomposition and matter recycling. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Grade 7

SC.7.FG.1 Explain how fungi interact with organisms and their environments and how they grow and reproduce under different conditions.

SC.7.FG.1.1 Explain how fungi interact with living organisms and their environment.

Example: Students are provided with images and descriptions of a North Florida forest ecosystem that includes mushrooms growing on decaying logs, fungal hyphae associated with the roots of a longleaf pine seedling, and microorganisms in the soil. The materials also provide observations from two forest areas: one with moist soil following several days

of rain and one with drier soil, as well as temperature changes in both areas, and the availability of organic material on the forest floors.

Student Task(s) –

Use the information in the scenario to explain how fungi interact with plants, animals, and microorganisms, including how fungi obtain nutrients from living or non-living sources.

Use evidence from the scenario to explain how environmental factors such as moisture, temperature, and available organic material influence fungal activity and how these interactions support ecosystem processes.

Benchmark Clarifications:

Clarification 1: Instruction includes interactions between fungi and living organisms such as plants, animals, and microorganisms.

Clarification 2: Instruction includes that fungi obtain nutrients from both living or non-living sources, depending on the species and environmental conditions.

Clarification 3: Instruction includes that fungi interact with abiotic factors such as moisture, temperature, and availability of organic material.

Clarification 4: Instruction includes explaining how fungal interactions support ecosystem processes such as decomposition and nutrient cycling.

Clarification 5: Instruction includes using examples or models to describe interactions between fungi, organisms, and environmental factors.

Clarification 6: Instruction includes identifying patterns in how environmental factors influence fungal activity and interactions in ecosystems. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes using models such as diagrams to represent interactions among fungi, organisms, and abiotic factors within ecosystems. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analysis of data, observations, or scenario-based evidence to explain how fungi interact with organisms and environmental factors. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 9: Instruction includes analyzing how fungal activity and interactions change over time under different environmental conditions. Refer to Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

SC.7.FG.1.2 Explain how fungi grow and reproduce in different environmental conditions.

Example: A seventh-grade science class examines results from a controlled laboratory investigation of a common bread mold conducted by scientists. The investigation compared fungal growth and spore production under different temperature and moisture conditions. Students are provided with photographs and data from the investigation and use the evidence to determine how the environmental conditions affect fungal growth and reproduction.

Condition	Temperature (°C)	Relative Humidity (%)	Fungal Growth After 5 Days (cm^2)	Spore Production
Warm and humid	28	85	18	Many
Warm and dry	28	35	6	Few
Cool and humid	12	85	3	Few

Simulated instructional data based on a controlled investigation.

Student Task(s) –

Analyze the data and photographs to identify patterns in fungal growth and spore production under the three environmental conditions.

Explain how differences in temperature and moisture affected fungal growth and reproduction.

Benchmark Clarifications:

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Clarification 1: Instruction includes that fungi grow by expanding and spreading into their environment.

Clarification 2: Instruction includes that fungi reproduce by producing spores that can spread to new locations.

Clarification 3: Instruction includes environmental conditions such as moisture, temperature, and availability of resources influence fungal growth and reproduction.

Clarification 4: Instruction is limited to a conceptual understanding of growth and reproduction and excludes cellular or molecular processes.

Clarification 5: Instruction includes identifying patterns in how fungal growth and reproduction change under different environmental conditions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or life cycle representations to illustrate how fungi grow, spread, and reproduce. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of observations, images, or data to explain how environmental conditions affect fungal growth and reproduction. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analyzing changes over time in fungal growth and spore production under different conditions. Refer to Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

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Grade 8

SC.8.FG.1 Analyze how fungi contribute to nutrient cycling and interact with organisms and environmental conditions to support ecosystem stability.

SC.8.FG.1.1 Explain how fungi contribute to nutrient cycling and ecosystem stability.

Proposed DRAFT Standards

Example: In a Florida cypress swamp, students examine data collected from two wetland areas after leaves and small branches accumulated on the water's edge. One area has typical fungal activity, while the other has reduced fungal activity. Students examine changes in the amount of decomposing plant material and available nutrients in the wetland soil over several months. A model shows how fungi break down dead plant material and return nutrients to the environment. Students use the evidence and model to explain how fungal activity contributes to nutrient cycling and supports stability in the wetland ecosystem.

Wetland Area	Fungal Activity	Decomposing Plant Material After 4 Months (kg/m^2)	Available Soil Nitrogen (mg/kg)
Area A	Typical	2.1	18
Area B	Reduced	3.8	10

Student Task(s) –

Analyze the data to identify patterns in decomposing plant material and available soil nutrients between the two wetland areas.

Use the data and model to explain how fungal activity contributes to nutrient cycling and supports ecosystem stability.

Benchmark Clarifications:

Clarification 1: Instruction includes that fungi act as decomposers that break down organic matter and return nutrients to the environment.

Clarification 2: Instruction includes that the recycled nutrients support the growth of other organisms and the functioning of ecosystems.

Clarification 3: Instruction includes that the movement and recycling of matter by fungi contribute to maintaining balance within ecosystems.

Clarification 4: Instruction includes explaining how fungal activity supports ecosystem stability through nutrient cycling and interactions among organisms.

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Clarification 5: Instruction includes using models or data to describe how fungal activity contributes to nutrient cycling and ecosystem stability.

Clarification 6: Instruction includes identifying patterns in how matter is recycled and reused within ecosystems over time. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes using models such as diagrams, cycles, or system representations to illustrate how fungi contribute to nutrient cycling and ecosystem stability. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analysis of data, scenarios, or observations to explain how fungal activity influences nutrient cycling and ecosystem function. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 9: Instruction includes analyzing how nutrient cycling and ecosystem stability are maintained over time through the activity of fungi. Refer to Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

SC.8.FG.1.2 Analyze how fungi interact with organisms and environmental factors within ecosystems.

Example: Case Study – In a Florida mangrove ecosystem, fungi are observed growing on fallen leaves, decaying roots, and in the wet soil surrounding mangrove trees. Data show that higher temperatures and increased moisture levels lead to greater fungal growth and faster breakdown of organic material. As fungi break down this material, nutrients become available in the soil, supporting plant growth and influencing the activity of microorganisms in the area. Models show that fungi obtain nutrients from both living plant roots and non-living organic matter in the environment.

Student Task(s) –

Analyze the case study to explain how fungi interact with plants and microorganisms and how these interactions influence other organisms in the mangrove ecosystem.

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Use evidence from the case study to explain how moisture, temperature, and available organic material affect fungal activity and how these interactions contribute to ecosystem processes.

Benchmark Clarifications:

Clarification 1: Instruction includes analyzing interactions between fungi and organisms such as

plants, animals, and microorganisms.

Clarification 2: Instruction includes that fungi obtain nutrients from both living and non-living sources and that these interactions influence other organisms.

Clarification 3: Instruction includes analyzing how abiotic factors such as moisture, temperature, and available organic material affect fungal activity.

Clarification 4: Instruction includes analyzing relationships between fungal interactions and ecosystem processes such as nutrient cycling and energy flow.

Clarification 5: Instruction includes using data, scenarios, or models to identify cause-and-effect relationships between fungal activity and ecosystem outcomes.

Clarification 6: Instruction includes identifying patterns and relationships in how environmental conditions influence fungal activity and ecosystem outcomes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes evaluating ecosystem models used to explain fungal interactions and environmental influences. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analysis of data, scenarios, or case studies to explain how fungal interactions influence organisms and ecosystem processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 9: Instruction includes analyzing changes over time in fungal activity and its effects on ecosystem processes under varying environmental conditions. Refer to Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

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Proposed DRAFT Standards

The Science of Microorganisms

How microscopic life is structured, how it functions, how it interacts with living systems, and how microorganisms shape ecosystems, human health, and life on Earth.

Grade 6

SC.6.MO.1 Explain that microorganisms are living organisms that exist in a wide range of environments and contribute to ecosystem processes.

SC.6.MO.1.1 Recognize that microorganisms are living organisms too small to be seen without magnification.

Example: Students examine a water sample collected from a freshwater pond in Wakulla Springs State Park. Using a microscope or provided microscope images, they observe microorganisms that cannot be seen with the naked eye and compare them to visible pond organisms such as fish, plants, and insects. Using magnified images, scale comparisons, and information about microscopes, students:

Describe observations at different magnifications.

Explain why microorganisms require magnification to be observed.

Use evidence from observations to compare microorganisms to larger visible objects found in the pond.

Explain how microscopes enable scientists to observe organisms that are too small to see directly.

Create a diagram or model showing the relative size of microorganisms compared to larger objects.

Benchmark Clarifications:

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Clarification 1: Instruction includes using microscopes or images to observe and identify microorganisms, such as bacteria, protists, and some fungi, as living organisms that require magnification to be seen.

Clarification 2: Instruction is limited to a conceptual understanding of microorganisms and excludes detailed classification or cellular processes.

Clarification 3: Instruction includes identifying patterns in how microscopes or magnification are used to observe organisms of different sizes. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 4: Instruction includes using models such as diagrams or scale representations to illustrate the size and characteristics of microorganisms. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes analysis of observations from microscopes, images, or scenarios to identify microorganisms as living organisms. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes recognizing how observation of microorganisms depends on tools and advances over time, such as the use of microscopes. Refer to the Timeline of Key Accomplishments Supporting Mastery of 6-8 Life Benchmarks.

SC.6.MO.1.2 Explain how microorganisms live in a variety of environments and perform roles in ecosystems.

Example: After a heavy summer rain, students examine soil and shallow standing water collected from two areas of a Florida schoolyard: a shaded garden bed and a sunny area near the basketball courts. Provided microscope images show microorganisms in both samples. The accompanying information identifies microorganisms involved in breaking down fallen leaves and other organic material in the garden soil and microorganisms living in the water. Students use the information to examine where the microorganisms are found and the roles they perform in their environments.

Student Task(s) –

Use the information and images to explain how microorganisms live in the soil and water environments represented in the investigation.

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Explain how the microorganisms contribute to ecosystem processes such as breaking down organic material and supporting the reuse of matter.

Use evidence from the two environments to describe how the locations where microorganisms are found relate to the roles they perform.

Benchmark Clarifications:

Clarification 1: Instruction includes that microorganisms can live in environments such as soil, water, air and within other living organisms.

Clarification 2: Instruction includes that microorganisms interact with both living and nonliving components of ecosystems.

Clarification 3: Instruction includes roles such as contributing to the breakdown of materials, supporting nutrient availability, and interacting with other organisms.

Clarification 4: Instruction includes using examples or models to describe how microorganisms function within ecosystems.

Clarification 5: Instruction includes that microorganisms contribute to the movement and reuse of matter within ecosystems at a conceptual level.

Clarification 6: Instruction includes identifying patterns in where microorganisms are found and how they function across different environments. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes using models such as diagrams or simple system representations to show how microorganisms interact with organisms and environmental components. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analysis of observations, images, or scenarios to explain where microorganisms live and how they function in ecosystems. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Proposed DRAFT Standards

Grade 7

SC.7.MO.1 Explain how microorganisms are classified and how they interact with living organisms and ecosystems.

SC.7.MO.1.1 Explain how common infectious agents that affect the human body are classified.

Example: A seventh-grade science class is creating a reference chart for the school's health office that compares four types of infectious agents: a virus, a bacterium, a fungus, and a parasite. Students are provided with descriptions and scientific images of each agent, including information about whether it is made of cells, whether it requires a host to reproduce and how it obtains resources. Students use the characteristics to classify each infectious agent.

Student Task(s) –

Use the provided characteristics to classify each infectious agent as a virus, bacterium, fungus, or parasite.

Explain how the characteristics used to classify each agent distinguish it from the other types of infectious agents.

Use the classification information to complete a comparison chart showing similarities and differences among the four types.

Benchmark Clarifications:

Clarification 1: Instruction includes common infectious agents such as viruses, bacteria, fungi, and parasitic organisms.

Clarification 2: Instruction includes that bacteria are prokaryotic organisms, fungi are eukaryotic organisms, and parasites are organisms that live in or on a host.

Clarification 3: Instruction includes that viruses are not classified as living organisms and require a host to reproduce.

Clarification 4: Instruction includes distinguishing characteristics used to classify different types of infectious agents.

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Clarification 5: Instruction is limited to general classification and characteristics and excludes detailed cellular structures, life cycles, or disease-specific mechanisms.

Clarification 6: Instruction includes identifying patterns in similarities and differences among infectious agents used for classification. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes using models such as charts, diagrams, or classification tables to compare different types of infectious agents. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analysis of images, data, or scenarios to identify and classify different infectious agents based on their characteristics. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.7.MO.1.2 Explain how microorganisms affect the health of organisms and the function of ecosystems.

Example: Students examine a case study of a Florida garden ecosystem containing bean plants, soil microorganisms, and insects. The case study describes bacteria associated with the bean plant roots, fungi decomposing fallen leaves, and microorganisms living on plant surfaces. Some microorganisms benefit the plants by making nutrients available, some have little measurable effect on the plants, and others can cause disease under certain conditions. Students examine observations of the plants and soil over several weeks and use the evidence to explain how microorganisms can have different effects on organisms and contribute to ecosystem processes.

Student Task(s) –

Classify the microorganism interactions described in the case study as beneficial, neutral, or harmful and use evidence to support each classification.

Explain how the effects of microorganisms on individual organisms connect to ecosystem processes such as decomposition and nutrient cycling.

Analyze the observations over time to identify patterns in how microorganism interactions affect the plants and ecosystem.

Proposed DRAFT Standards

Benchmark Clarifications:

Clarification 1: Instruction includes that microorganisms interact with organisms in ways that influence health and biological processes.

Clarification 2: Instruction includes that microorganisms can have beneficial, neutral, or harmful interactions with organisms.

Clarification 3: Instruction includes that microorganisms play roles in ecosystems such as nutrient cycling, decomposition, and interactions with other organisms.

Clarification 4: Instruction includes explaining how the effects of microorganisms at the organism level connect to their roles in ecosystem processes.

Clarification 5: Instruction includes using examples or models to describe how microorganisms influence both individual organisms and ecosystem processes.

Clarification 6: Instruction includes identifying patterns in beneficial, neutral, and harmful interactions between microorganisms and organisms. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes using models such as diagrams or system representations to illustrate how microorganisms interact with organisms and contribute to ecosystem function. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analysis of data, observations, or scenarios to explain how microorganisms affect the health of organisms and ecosystem processes. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Grade 8

SC.8.MO.1 Analyze how microorganisms contribute to energy flow and matter cycling and influence environmental and human systems.

SC.8.MO.1.1 Explain how microorganisms contribute to energy flow and matter cycling in ecosystems.

Example: Students examine a food web from a Florida freshwater pond that includes algae, bacteria, microscopic consumers, insects, and fish. The food web shows bacteria breaking down dead organisms and algae serving as a food source for microscopic consumers. Students use the food web and accompanying information to explain how microorganisms contribute to both the movement of energy through the ecosystem and the recycling of matter.

Student Task(s) –

Use the food web to trace how energy moves through organisms that interact with microorganisms.

Explain how microorganisms contribute to the movement of energy and the recycling of matter within the pond ecosystem.

Use evidence from the food web to explain how the roles of microorganisms support ecosystem processes.

Benchmark Clarifications:

Clarification 1: Instruction includes that microorganisms can function as producers, consumers, or decomposers within ecosystems.

Clarification 2: Instruction includes that microorganisms contribute to matter cycling by breaking down organic materials and returning nutrients to the environment.

Clarification 3: Instruction includes that microorganisms contribute to energy flow through food webs by transferring energy between organisms.

Clarification 4: Instruction includes explaining how the roles of microorganisms support ecosystem processes such as energy flow and matter cycling.

Clarification 5: Instruction includes using models, diagrams, or data to describe how microorganisms contribute to energy flow and matter cycling in ecosystems.

Clarification 6: Instruction includes identifying patterns in how energy moves through food webs and how matter is recycled within ecosystems. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

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Clarification 7: Instruction includes using models such as food webs, nutrient cycles, or system diagrams to illustrate how microorganisms contribute to energy flow and matter cycling. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 8: Instruction includes analysis of data, scenarios, or observations to explain how microorganisms influence energy flow and matter cycling. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.MO.1.2 Analyze how microorganisms influence environmental and human systems.

Example: Case Study – In a Florida classroom investigation, students review data about microorganisms living in the human digestive system. The data show that certain microorganisms help break down food, release nutrients, and interact with other organisms in the body. Additional information shows that these microorganisms are influenced by environmental factors such as the types of food consumed and exposure to microbes in soil and water.

Condition	Microbial Activity (relative units)	Nutrient Availability (mg/L)	Digestive Process Rating*
Typical microbial community	82	74	4
Reduced microbial community	51	52	2
Increased microbial community	91	79	4

1 = low; 4 = high. Simulated instructional data.

Student Task(s) –

Analyze the case study data to explain how microorganisms interact with both environmental systems and the human digestive system to support normal body functions.

Use evidence from the scenario to explain how microorganisms benefit human systems and describe the relationship between environmental factors and microbial activity.

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Benchmark Clarifications:

Clarification 1: Instruction includes analyzing how microorganisms interact with environmental systems such as soil, water, and air.

Clarification 2: Instruction includes that microorganisms influence systems in multiple ways, including contributing to ecosystem processes and interacting with organisms.

Clarification 3: Instruction includes analyzing how microorganisms affect human systems through interactions within the body and through environmental resources.

Clarification 4: Instruction includes analyzing relationships between microbial activity and outcomes in environmental and human systems.

Clarification 5: Instruction includes identifying patterns in how environmental factors influence microbial activity and related outcomes in human and ecosystem systems. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as system diagrams to represent interactions between microorganisms, environmental systems, and human body systems and predicting how changes in environmental conditions may affect microorganism activity and system outcomes. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of data, case studies, or observations to explain how microorganisms influence both environmental and human systems. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Applying the Science of Life

How scientific understanding of living systems is used to improve health, manage resources, solve biological problems, and make informed decisions.

Grade 6

Proposed DRAFT Standards

SC.6.ASL.1 Apply knowledge of ecosystems, organism interactions, and biological concepts to analyze problems and propose evidence-based solutions.

SC.6.ASL.1.1 Apply knowledge of ecosystems, organism interactions, and environmental factors to analyze problems and propose evidence-based solutions.

Example: Students are provided with data, maps, and ecosystem models for Wakulla Springs in the Florida Panhandle, showing changes over time in water clarity, nutrient levels, and organism populations. The materials include trends such as increased nutrient levels, decreased water clarity, and shifts in plant and animal populations.

Year	Nitrate in Spring Water (mg/L)	Water Clarity (m)	Aquatic Plant Cover (%)	Fish Population (fish/100 m^2)
2022	0.8	12.0	72	38
2023	1.1	10.5	65	34
2024	1.5	8.7	54	29
2025	1.9	7.1	43	24

Student Task(s) –

Analyze the data, map, and models to identify at least two cause-and-effect relationships among nutrient levels, water clarity, and organism populations in the ecosystem.

Describe how a change in one ecosystem factor may have contributed to changes in other ecosystem components.

Use evidence from the data, maps, or models to support your explanation.

Based on the evidence, propose one solution that could improve ecosystem stability.

Benchmark Clarifications:

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Clarification 1: Instruction includes biotic and abiotic factors, population dynamics, and ecosystem structure.

Clarification 2: Instruction includes proposing and evaluating evidence-based solutions to ecosystem problems, including potential benefits and limitations.

Clarification 3: Instruction includes explaining how changes in one part of an ecosystem can affect other components.

Clarification 4: Instruction is limited to conceptual ecosystem analysis and excludes advanced ecological modeling or policy advocacy.

Clarification 5: Instruction includes identifying patterns, trends, and cause-and-effect relationships in environmental data and evidence to support analysis and conclusions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as diagrams or system representations to illustrate ecosystem relationships and proposed solutions. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of real or simulated data, maps, or ecosystem models to identify relationships and support conclusions. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.ASL.1.2 Apply understanding of classification systems, organism characteristics, and cellular processes to interpret information about how living organisms function and survive.

Example: Students examine information about the American alligator, including its classification as a reptile, photographs showing characteristics of its body, and information about how its cells obtain energy through cellular respiration. The information also describes how alligators survive in Florida's freshwater wetlands, including how their body characteristics support survival in that environment. Students use the classification information and evidence about the organism's characteristics and cellular processes to interpret how the alligator functions and survives in its environment.

Student Task(s) –

Use the classification information to identify characteristics that place the American alligator in the reptile group.

Analyze the photographs and information to identify characteristics that help the alligator function in its freshwater wetland environment.

Use information about cellular respiration and oxygen use to explain how a characteristic of the alligator supports its ability to survive.

Benchmark Clarifications:

Clarification 1: Instruction includes using classification systems to organize organisms and infer relationships based on shared characteristics.

Clarification 2: Instruction includes applying knowledge of organism characteristics and cellular processes to explain how organisms survive in different environments.

Clarification 3: Instruction is limited to benchmark expectations and excludes memorization of detailed organism characteristics or classification systems.

Clarification 4: Instruction includes identifying patterns in shared characteristics used to classify organisms and explain their functions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using models such as classification charts, diagrams, or representations to illustrate relationships among organisms and their structures. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data, images, evidence, or scenarios to interpret characteristics, classification, and survival of organisms. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.6.ASL.2 Use scientific models, data, and evidence to interpret information and support decisions related to living systems.

SC.6.ASL.2.1 Use scientific models, data, and evidence to make and support decisions related to living systems and real-world applications.

Proposed DRAFT Standards

Example: A sixth-grade class is helping decide which plants to add to a school butterfly garden. Students are provided with information about three plant choices, including the number of butterfly species observed visiting each plant, the amount of water each plant requires and how well each plant survived during a period of limited rainfall. Students also examine a model showing how the plants provide food or habitat for organisms in the garden. Students use the evidence to select a plant and support their decision.

Plant	Butterfly Species Observed	Water Needed per Week (L)	Plants Surviving After 4 Weeks of Limited Rainfall
Plant A	6	12	8/10
Plant B	4	7	9/10
Plant C	8	15	6/10

Student Task(s) –

Analyze the data and model to compare the three plant choices.

Select one plant for the butterfly garden and use evidence from the data and model to support the decision.

Identify one potential benefit and one limitation of the selected plant.

Benchmark Clarifications:

Clarification 1: Instruction includes constructing evidence-based explanations or arguments related to biological problems.

Clarification 2: Instruction includes using evidence to make and support decisions by considering evidence, outcomes, and limitations about real-world situations involving living systems.

Clarification 3: Instruction includes examining how professionals use scientific research, models, and environmental data to inform conservation and resource management decisions.

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Clarification 4: Instruction is limited to conceptual application of scientific reasoning and excludes advanced quantitative modeling or formal scientific argument frameworks.

Clarification 5: Instruction includes identifying patterns and trends in biological data to support reasoning and conclusions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using and evaluating models such as diagrams or system representations to support explanations and decisions about biological systems. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of data, scenarios, or investigations to make and support decisions about living systems. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

Grade 7

SC.7.ASL.1 Explain how biotechnology uses living organisms and biological systems to develop products and technologies that impact human life, health, and the environment.

SC.7.ASL.1.1 Describe examples of biotechnology and how they are used to improve human health, the environment, and everyday life.

Example: Case Study – Students are presented with a set of real-world situations showing how biotechnology is used in different fields:

Medicine: Scientists use biotechnology to develop treatments such as insulin therapies for diabetes and diagnostic tests to monitor blood sugar levels and heart health.

Agriculture: Farmers use crops that are engineered to resist pests and tolerate drought conditions.

Industry: Microorganisms are used to produce biofuels and create biodegradable products.

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Environmental Science: Microorganisms are used to break down oil spills and reduce pollutants in contaminated environments.

Students review short descriptions, diagrams, or images for each scenario showing how living organisms or their components are used to address problems or improve systems.

Student Task(s) –

Analyze the scenarios and identify how biotechnology is being used.

Use evidence from the scenarios to explain how biotechnology improves human life or the environment.

Benchmark Clarifications:

Clarification 1: Instruction includes that biotechnology is the use of living organisms or their components to develop products, processes, or technologies.

Clarification 2: Instruction includes examples of biotechnology used in medicine, agriculture, industry, and environmental science.

Clarification 3: Instruction includes recognizing how biotechnology applications address real-world problems and improve human life or environmental conditions.

Clarification 4: Instruction is limited to recognition and general understanding of biotechnology applications through examples, models, and simple investigations and excludes detailed genetic engineering processes or technical mechanisms.

Clarification 5: Instruction includes identifying patterns in how biotechnology is used and classifying biotechnology applications based on their purpose or field of use. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes using models such as charts, diagrams, or concept maps to categorize and represent different biotechnology applications and their impacts. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 7: Instruction includes analysis of scenarios, case studies, or examples to identify biotechnology applications and explain their uses. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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Proposed DRAFT Standards

Grade 8

SC.8.ASL.1 Analyze and evaluate how changes in ecosystem processes influence organisms and systems, and use models, data, and evidence to explain, predict, and propose solutions.

SC.8.ASL.1.1 Analyze and evaluate how disruptions to ecosystem processes, including energy flow and matter cycling, affect organisms and propose evidence-based solutions.

Example: An eighth-grade science class examines changes in a Florida coastal bay where seagrass beds have declined over several years. Students are provided with data showing changes in water clarity, seagrass coverage, dissolved oxygen, and juvenile fish abundance. A model shows how seagrass captures energy through photosynthesis, stores carbon and provides habitat for other organisms. Students analyze and evaluate the evidence to determine how the decline in seagrass affects energy flow, matter cycling, and organisms in the bay. They then propose an evidence-based solution to reduce the disruption.

Year	Water Clarity (m)	Seagrass Coverage (%)	Dissolved Oxygen (mg/L)	Juvenile Fish (fish/100 m^2)
2022	4.8	72	7.9	46
2023	4.2	64	7.5	41
2024	3.5	53	6.9	34
2025	2.8	41	6.2	27

Student Task(s) –

Analyze the data to identify trends in water clarity, seagrass coverage, dissolved oxygen, and juvenile fish abundance.

Use the data and ecosystem model to explain how declining seagrass coverage may disrupt energy flow and matter cycling in the bay.

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Propose one evidence-based solution to reduce the disruption.

Benchmark Clarifications:

Clarification 1: Instruction includes disruptions to ecosystem processes such as photosynthesis, cellular respiration, and the carbon cycle.

Clarification 2: Instruction includes analyzing cause-and-effect relationships between environmental changes, disruptions to energy flow and matter cycling, and their effects on organisms, populations, and ecosystem stability.

Clarification 3: Instruction is limited to conceptual and data-based analysis of ecosystem processes and excludes advanced biochemical or climate modeling.

Clarification 4: Instruction includes identifying patterns and trends in environmental data to evaluate changes in ecosystem processes and support conclusions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using and evaluating models such as system diagrams, food webs, or carbon cycle representations to illustrate how disruptions affect energy flow, matter cycling, and ecosystem stability, and to represent proposed solutions. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data, case studies, or environmental scenarios to explain how disruptions to ecosystem processes affect organisms and systems, and to support evidence-based solutions. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

SC.8.ASL.1.2 Use models, data, and evidence to explain and predict how changes in environmental conditions influence organism survival, adaptation, and ecosystem stability.

Example: An eighth-grade science class examines a population of Eastern oysters in a Florida estuary where water temperature has increased during summer months. Students are provided with data showing water temperature and oyster survival for several locations and a model showing how oysters with different shell-closing responses respond to periods of warmer water. Students use the evidence and model to explain how the

environmental change affects oyster survival and predict which trait would be more likely to support survival if water temperatures continue to increase.

Estuary Site	Average Summer Water Temperature (°C)	Oyster Survival After 30 Days (%)
Site A	27	91
Site B	29	84
Site C	31	68
Site D	33	49

Oyster Trait	Response to Warmer Conditions
Closes shell quickly when exposed to stressful conditions	Reduces water loss and exposure
Closes shell slowly	Remains exposed to surrounding water for longer periods

Student Task(s) –

Analyze the data to identify the relationship between water temperature and oyster survival.

Predict which oyster trait would be more likely to support survival if water temperatures continue to increase and use evidence to support the prediction.

Explain how changes in oyster survival could affect the stability of the estuary ecosystem.

Benchmark Clarifications:

Clarification 1: Instruction includes connecting changes in abiotic and biotic factors to biological responses in organisms and populations and to outcomes at the ecosystem level.

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Clarification 2: Instruction includes constructing and supporting evidence-based explanations and predictions about how environmental changes affect survival, adaptation, and ecosystem stability, including how environmental conditions can influence which traits support survival.

Clarification 3: Instruction is limited to conceptual explanations and predictions using evidence and excludes detailed genetic mechanisms or advanced ecological modeling.

Clarification 4: Instruction includes identifying patterns and trends in environmental and biological data to support explanations and predictions. Refer to Mathematics Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 5: Instruction includes using and evaluating models such as system diagrams, food webs, or representations of environmental change to illustrate relationships among environmental factors, organism responses, and ecosystem outcomes, and to support predictions about environmental change. Refer to Modeling Skills Supporting Mastery of 6-8 Life Benchmarks.

Clarification 6: Instruction includes analysis of data, case studies, or environmental scenarios to explain and predict how changes in environmental conditions affect organisms and ecosystem stability. Refer to Laboratory Practices Supporting Mastery of 6-8 Life Benchmarks.

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