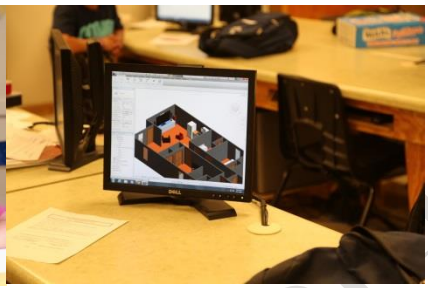
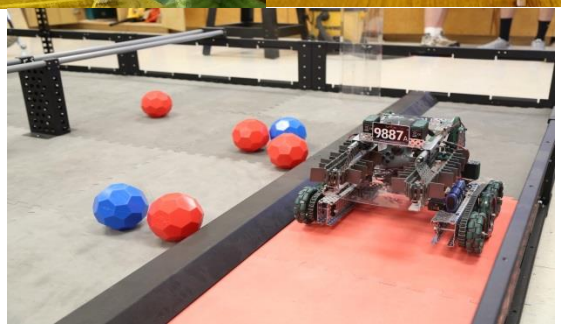
SUPPORT GUIDE FOR GRADE FOUR SOUTH CAROLINA ACADEMIC STANDARDS AND PERFORMANCE INDICATORS FOR SCIENCE

Molly M. Spearman
State Superintendent of Education

SOUTH CAROLINA
STATE DEPARTMENT
OF EDUCATION





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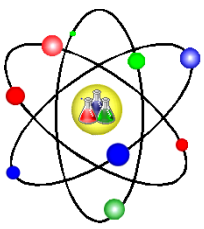


INTRODUCTION TO GRADE FOUR STANDARDS

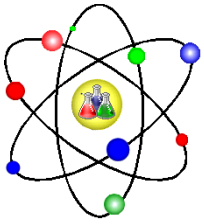
Science is a way of understanding the physical universe using observation and experimentation to explain natural phenomena. Science also refers to an organized body of knowledge that includes core ideas to the disciplines and common themes that bridge the disciplines. This document, *South Carolina Academic Standards and Performance Indicators for Science,* contains the academic standards in science for the state's students in kindergarten through grade twelve.

ACADEMIC STANDARDS

In accordance with the South Carolina Education Accountability Act of 1998 (S.C. Code Ann. § 59-18-110), the purpose of academic standards is to provide the basis for the development of local curricula and statewide assessment. Consensually developed academic standards describe for each grade and high school core area the specific areas of student learning that are considered the most important for proficiency in the discipline at the particular level.

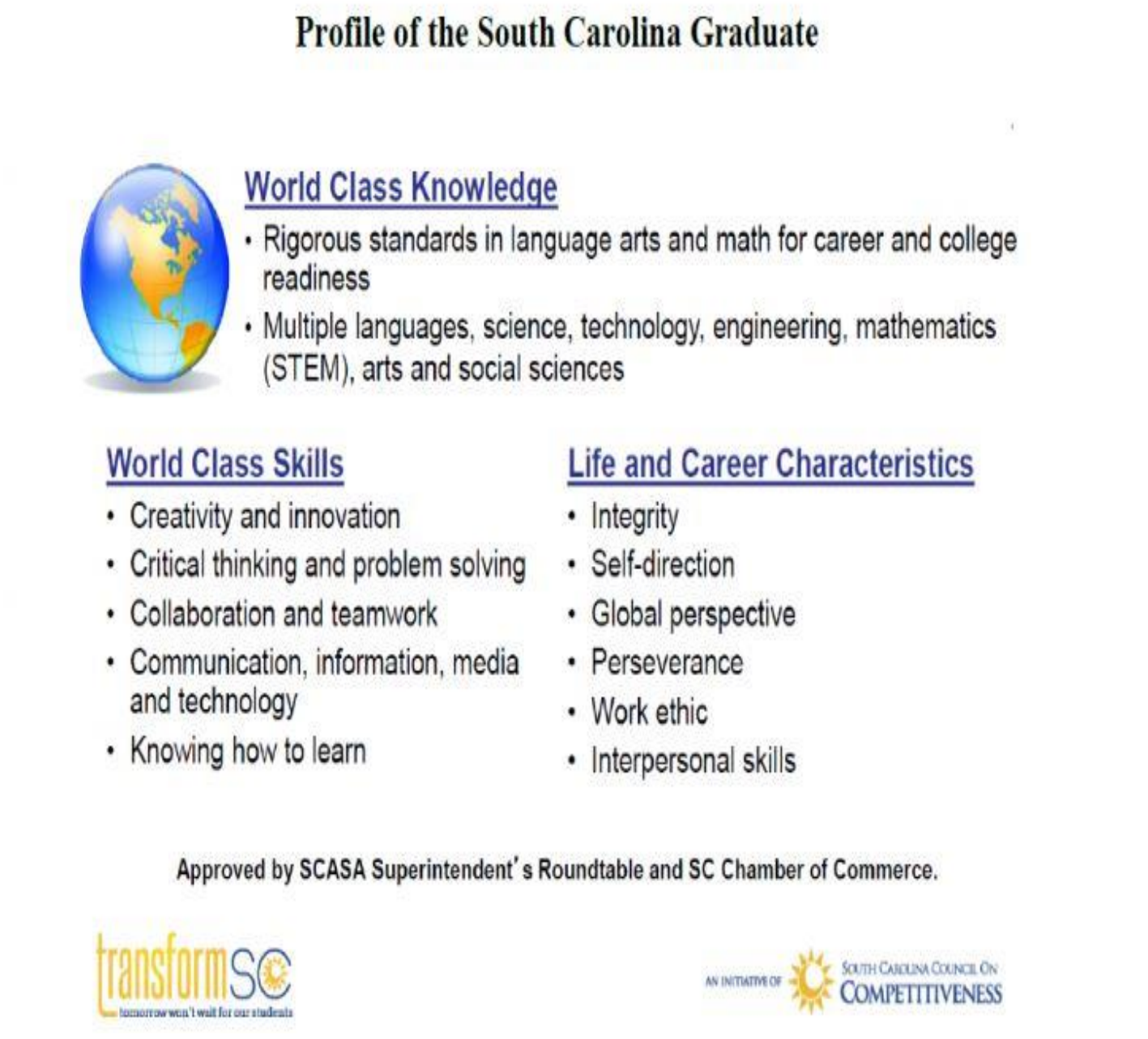
Operating procedures for the review and revision of all South Carolina academic standards were jointly developed by staff at the State Department of Education (SCDE) and the Education Oversight Committee (EOC). According to these procedures, a field review of the first draft of the revised South Carolina science standards was conducted from March through May 2013. Feedback from that review and input from the SCDE and EOC review panels was considered and used to develop these standards.

The academic standards in this document are not sequenced for instruction and do not prescribe classroom activities; materials; or instructional strategies, approaches, or practices. The *South Carolina Academic Standards and Performance Indicators for Science* is not a curriculum.



THE PROFILE OF THE SOUTH CAROLINA GRADUATE

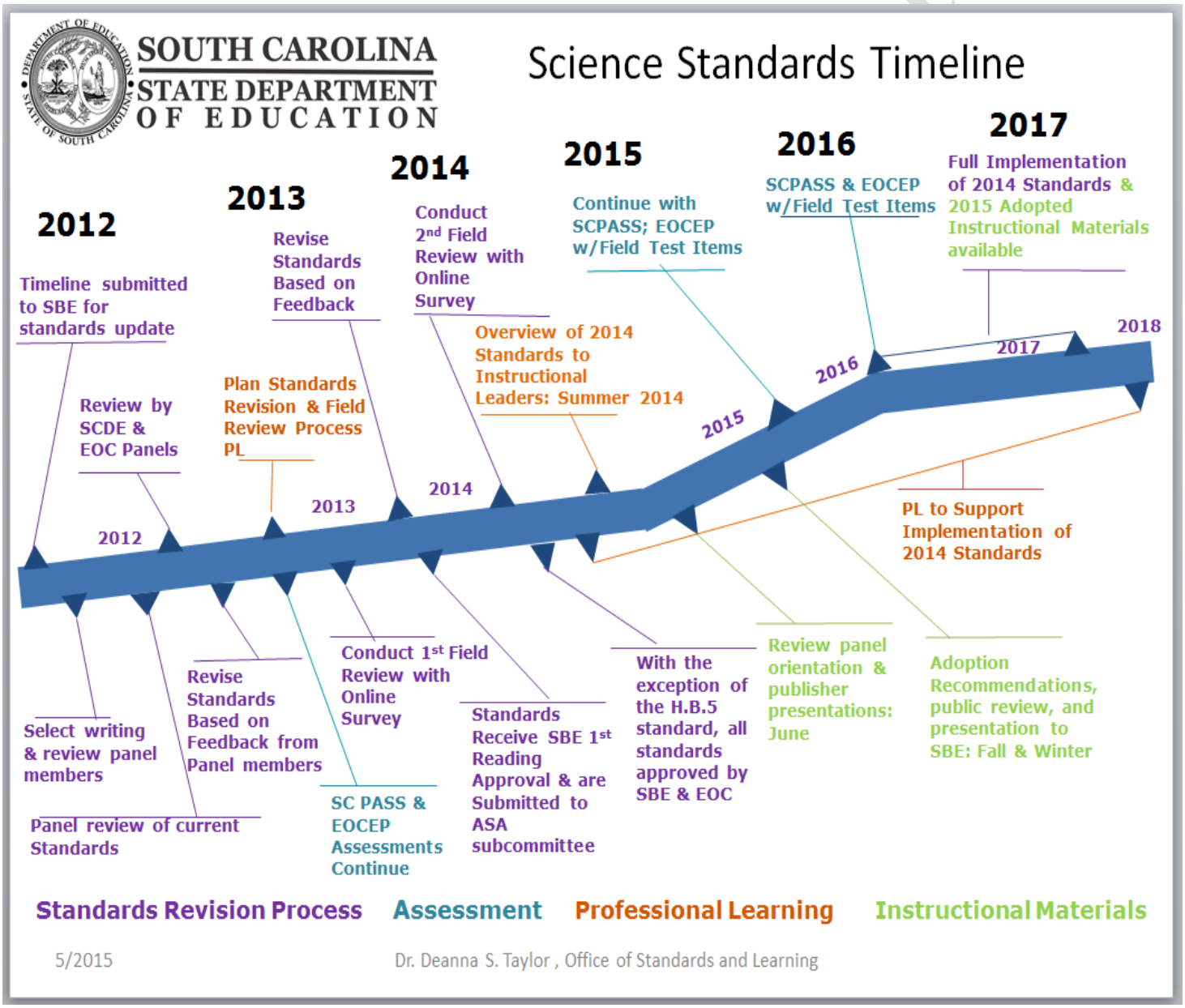
The *2014 South Carolina Academic Standards and Performance Indicators for Science* support the *Profile of the South Carolina Graduate. The Profile of the South Carolina Graduate* has been adopted and approved by the South Carolina Association of School Administrators (SCASA), the South Carolina Chamber of Commerce, the South Carolina Council on Competitiveness, the Education Oversight Committee (EOC), the State Board of Education (SBE), and the South Carolina Department of Education (SCDE) in an effort to identify the knowledge, skills, and characteristics a high school graduate should possess in order to be prepared for success as they enter college or pursue a career. The profile is intended to guide all that is done in support of college- and career-readiness.



SCIENCE STANDARDS TIMELINE

This timeline is used to illustrate the timeline for the standards revisions process, student assessment administration, provision of professional learning and the review and adoption of instructional materials. This timeline may be used with the science academic standards, science and engineering support document, and grade/content support documents to assist local districts, schools and teachers as they construct standards-based science curriculum, allowing them to add or expand topics they feel are important and to organize content to fit their students' needs and match available instructional materials.

The timeline in this document does not offer a sequence for instruction and do not prescribe classroom activities; materials; or instructional strategies, approaches, or practices. The *Science Standards Timeline*, is not a curriculum.



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CROSSCUTTING CONCEPTS

Seven common threads or themes are presented in *A Framework for K-12 Science Education* (2012). These concepts connect knowledge across the science disciplines (biology, chemistry, physics, earth and space science) and have value to both scientists and engineers because they identify universal properties and processes found in all disciplines. These crosscutting concepts are:

1. Patterns
2. Cause and Effect: Mechanism and Explanation
3. Scale, Proportion, and Quantity
4. Systems and System Models
5. Energy and Matter: Flows, Cycles, and Conservation
6. Structure and Function
7. Stability and Change

These concepts should not to be taught in isolation but reinforced in the context of instruction within the core science content for each grade level or course.

SCIENCE AND ENGINEERING PRACTICES

In addition to the academic standards, each grade level or high school course explicitly identifies S*cience and Engineering Practice* standards, with indicators that are differentiated across grade levels and core areas. The term "practice" is used instead of the term "skill," to emphasize that scientists and engineers use skill and knowledge simultaneously, not in isolation. These eight science and engineering practices are:

1. Ask questions and define problems
2. Develop and use models
3. Plan and conduct investigations
4. Analyze and interpret data
5. Use mathematical and computational thinking
6. Construct explanations and design solutions
7. Engage in scientific argument from evidence
8. Obtain, evaluate, and communicate information

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade levels and courses. It is critical that educators understand that the Science and Engineering Practices are *not* to be taught in isolation. There should *not* be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed *within the content* for each grade level or course.

Additionally, an important component of all scientists and engineers' work is communicating their results both by informal and formal speaking and listening, and formal reading and writing. Speaking, listening, reading and writing is important not only for the purpose of sharing results, but because during the processes of reading, speaking, listening and writing, scientists and engineers continue to construct their own knowledge and understanding of meaning and implications of their research. Knowing how one's results connect to previous results and what those connections reveal about the underlying principles is an important part of the scientific discovery process. Therefore, students should similarly be reading, writing, speaking and listening throughout the scientific processes in which they engage.

For additional information regarding the development, use and assessment of the *2014 Academic Standards and Performance Indicators for Science* please see the official document that is posted on the SCDE science web page--- http://tinyurl.com/2014SCScience.

DECIPHERING THE STANDARDS

KINDERGARTEN
LIFE SCIENCE: EXPLORING ORGANISMS AND THE ENVIRONMENT

Standard K.L.2: The student will demonstrate an understanding of organisms found in the environment and how these organisms depend on the environment to meet those needs.

K.L.2A. Conceptual Understanding: The environment consists of many types of organisms including plants, animals, and fungi. Organisms depend on the land, water, and air to live and grow. Plants need water and light to make their own food. Fungi and animals cannot make their own food and get energy from other sources. Animals (including humans) use different body parts to obtain food and other resources needed to grow and survive. Organisms live in areas where their needs for air, water, nutrients, and shelter are met.

Performance Indicators: Students who demonstrate this understanding can:

K.L.2A.1 Obtain information to answer questions about different organisms found in the environment (such as plants, animals, or fungi).

K.L.2A.2 Conduct structured investigations to determine what plants need to live and grow (including water and light).

Figure 1: Example from the Kindergarten Standards

The code assigned to each performance indicator within the standards is designed to provide information about the content of the indicator. For example, the **K.L.2A.1** indicator decodes as the following--

- **K: The first part of each indicator denotes the grade or subject.** The example indicator is from Kindergarten. The key for grade levels are as follows—

  K: Kindergarten
  1: First Grade
  2: Second Grade
  3: Third Grade
  4: Fourth Grade
  5: Fifth Grade
  6: Sixth Grade
  7: Seventh Grade
  8: Eighth Grade
  H.B: High School Biology 1
  H.C: High School Chemistry 1
  H.P: High School Physics 1
  H.E: High School Earth Science

- **L: After the grade or subject, the content area is denoted by an uppercase letter.** The L in the example indicator means that the content covers Life Science. The key for content areas are as follows—
    - E: Earth Science
    - EC: Ecology
    - L: Life Science
    - P: Physical Science
    - S: Science and Engineering Practices

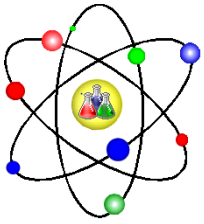
- **2: The number following the content area denotes the specific academic standard.** In the example, the 2 in the indicator means that it is within the second academic standard with the Kindergarten science content.

- **A: After the specific content standard, the conceptual understanding is denoted by an uppercase letter.** The conceptual understanding is a statement of the core idea for which students should demonstrate understanding. There may be more than one conceptual understanding per academic standard. The A in the example means that this is the first conceptual understanding for the standard. Additionally, the conceptual understandings are novel to the *2014 South Carolina Academic Standards and Performance Indicators for Science*.

- **1: The last part of the code denotes the number of the specific performance indicator.** Performance indicators are statements of what students can do to demonstrate knowledge of the conceptual understanding. The example discussed is the first performance indicator within the conceptual understanding.

CORE AREAS OF GRADE FOUR

- Weather and Climate
- Stars and the Solar System
- Forms of Energy – Light and Sound
- Characteristics and Growth of Organisms



GRADE FOUR
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected at this grade level. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard 4.S.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

4.S.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

4.S.1A.1 Ask questions that can be (1) answered using scientific investigations or (2) used to refine models, explanations, or designs.

4.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

4.S.1A.3 Plan and conduct scientific investigations to answer questions, test predictions and develop explanations: (1) formulate scientific questions and predict possible outcomes, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

4.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support explanations, claims, or designs.

4.S.1A.5 Use mathematical and computational thinking to (1) express quantitative observations using appropriate English or metric units, (2) collect and analyze data, or (3) understand patterns, trends and relationships between variables.

4.S.1A.6 Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

4.S.1A.7 Construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

4.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4) support explanations, claims, or designs. Communicate observations and explanations using the conventions and expectations of oral and written language.

4.S.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

4.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

EARTH SCIENCE: WEATHER AND CLIMATE

Standard 4.E.2: The student will demonstrate an understanding of the water cycle and weather and climate patterns.

4.E.2A. Conceptual Understanding: Earth's atmosphere is a mixture of gases, including water vapor and oxygen. The movement of water, which is found almost everywhere on Earth including the atmosphere, changes form and cycles between Earth's surface and the air and back again. This cycling of water is driven by energy from the Sun. The movement of water in the water cycle is a major pattern that influences weather conditions. Clouds form during this cycle and various types of precipitation result.

Performance Indicators: Students who demonstrate this understanding can:

4.E.2A.1 Obtain and communicate information about some of the gases in the atmosphere (including oxygen, nitrogen, and water vapor) to develop models that exemplify the composition of Earth's atmosphere where weather takes place.

4.E.2A.2 Develop and use models to explain how water changes as it moves between the atmosphere and Earth's surface during each phase of the water cycle (including evaporation, condensation, precipitation, and runoff).

4.E.2B. Conceptual Understanding: Scientists record patterns in weather conditions across time and place to make predictions about what kind of weather might occur next. Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over long periods of time. Some weather conditions lead to severe weather phenomena that have different effects and safety concerns.

Performance Indicators: Students who demonstrate this understanding can:

4.E.2B.1 Analyze and interpret data from observations, measurements, and weather maps to describe patterns in local weather conditions (including temperature, precipitation, wind speed/direction, relative humidity, and cloud types) and predict changes in weather over time.

4.E.2B.2 Obtain and communicate information about severe weather phenomena (including thunderstorms, hurricanes, and tornadoes) to explain steps humans can take to reduce the impact of severe weather phenomena.

4.E.2B.3 Construct explanations about regional climate differences using data from the long term weather conditions of the region**.**

EARTH SCIENCE: STARS AND THE SOLAR SYSTEM

Standard 4.E.3: The student will demonstrate an understanding of the locations, movements, and patterns of stars and objects in the solar system.

4.E.3A. Conceptual Understanding: Astronomy is the study of objects in our solar system and beyond. A solar system includes a sun, (star), and all other objects that orbit that sun. Planets in our night sky change positions and are not always visible from Earth as they orbit our Sun. Stars that are beyond the solar system can be seen in the night sky in patterns called constellations. Constellations can be used for navigation and appear to move together across the sky because of Earth's rotation.

Performance Indicators: Students who demonstrate this understanding can:

4.E.3A.1 Develop and use models of Earth's solar system to exemplify the location and order of the planets as they orbit the Sun and the main composition (rock or gas) of the planets.

4.E.3A.2 Obtain and communicate information to describe how constellations (including Ursa Major, Ursa Minor, and Orion) appear to move from Earth's perspective throughout the seasons.

4.E.3A.3 Construct scientific arguments to support claims about the importance of astronomy in navigation and exploration (including the use of telescopes, astrolabes, compasses, and sextants).

4.E.3B. Conceptual Understanding: Earth orbits around the Sun and the Moon orbits around Earth. These movements together with the rotation of Earth on a tilted axis result in patterns that can be observed and predicted.

Performance Indicators: Students who demonstrate this understanding can:

4.E.3B.1 Analyze and interpret data from observations to describe patterns in the (1) location, (2) movement, and (3) appearance of the Moon throughout the year.

4.E.3B.2 Construct explanations of how day and night result from Earth's rotation on its axis.

4.E.3B.3 Construct explanations of how the Sun appears to move throughout the day using observations of shadows.

4.E.3B.4 Develop and use models to describe the factors (including tilt, revolution, and angle of sunlight) that result in Earth's seasonal changes.

PHYSICAL SCIENCE: FORMS OF ENERGY – LIGHT AND SOUND

Standard 4.P.4: The student will demonstrate an understanding of the properties of light and sound as forms of energy.

4.P.4A. Conceptual Understanding: Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicators: Students who demonstrate this understanding can:

4.P.4A.1 Construct scientific arguments to support the claim that white light is made up of different colors.

4.P.4A.2 Analyze and interpret data from observations and measurements to describe how the apparent brightness of light can vary as a result of the distance and intensity of the light source.

4.P.4A.3 Obtain and communicate information to explain how the visibility of an object is related to light.

4.P.4A.4 Develop and use models to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption) using evidence from observations.

4.P.4A.5 Plan and conduct scientific investigations to explain how light behaves when it strikes transparent, translucent, and opaque materials.

4.P.4B. Conceptual Understanding: Sound, as a form of energy, is produced by vibrating objects and has specific properties including pitch and volume. Sound travels through air and other materials and is used to communicate information in various forms of technology.

Performance Indicators: Students who demonstrate this understanding can:

4.P.4B.1 Plan and conduct scientific investigations to test how different variables affect the properties of sound (including pitch and volume).

4.P.4B.2 Analyze and interpret data from observations and measurements to describe how changes in vibration affects the pitch and volume of sound.

4.P.4B.3 Define problems related to the communication of information over a distance and design devices or solutions that use sound to solve the problem.

LIFE SCIENCE: CHARACTERISTICS AND GROWTH OF ORGANISMS

Standard 4.L.5: The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.

4.L.5A. Conceptual Understanding: Scientists have identified and classified many types of plants and animals. Each plant or animal has a unique pattern of growth and development called a life cycle. Some characteristics (traits) that organisms have are inherited and some result from interactions with the environment.

Performance Indicators: Students who demonstrate this understanding can:

4.L.5A.1 Obtain and communicate information about the characteristics of plants and animals to develop models which classify plants as flowering or nonflowering and animals as vertebrate or invertebrate.

4.L.5A.2 Analyze and interpret data from observations and measurements to compare the stages of development of different seed plants.

4.L.5A.3 Develop and use models to compare the stages of growth and development in various animals.

4.L.5A.4 Construct scientific arguments to support claims that some characteristics of organisms are inherited from parents and some are influenced by the environment.

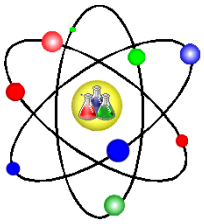
4.L.5B. Conceptual Understanding: Plants and animals have physical characteristics that allow them to receive information from the environment. Structural adaptations within groups of plants and animals allow them to better survive and reproduce.

Performance Indicators: Students who demonstrate this understanding can:

4.L.5B.1 Develop and use models to compare how humans and other animals use their senses and sensory organs to detect and respond to signals from the environment.

4.L.5B.2 Construct explanations for how structural adaptations (such as the types of roots, stems, or leaves; color of flowers; or seed dispersal) allow plants to survive and reproduce.

4.L.5B.3 Construct explanations for how structural adaptations (such as methods for defense, locomotion, obtaining resources, or camouflage) allow animals to survive in the environment.



GRADE FOUR CROSSWALK FOR THE 2005 SOUTH CAROLINA SCIENCE ACADEMIC STANDARDS AND THE 2014 SOUTH CAROLINA ACADEMIC STANDARDS AND PERFORMANCE INDICATORS FOR SCIENCE

ACKNOWLEDGEMENTS

SOUTH CAROLINA DEPARTMENT OF EDUCATION

The *Crosswalks for the South Carolina Academic Standards and Performance Indicators for Science* included in this document were developed under the direction of Dr. Julie Fowler, Deputy Superintendent, Division of College and Career Readiness and Cathy Jones Stork, Interim Director, Office of Standards and Learning.

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INTRODUCTION

This document, *Crosswalks for the 2005 South Carolina Science Academic Standards and the 2014 South Carolina Academic Standards and Performance Indicators for Science,* contains a comparison of the academic standards in science for the state's students in kindergarten through grade twelve.

HOW TO USE THE CROSSWALKS

This document may be used with the science academic standards, science and engineering support document, and grade/content support documents to assist local districts, schools and teachers as they construct standards-based science curriculum, allowing them to add or expand topics they feel are important and to organize content to fit their students' needs and match available instructional materials. 2005 and 2014 performance indicators that share similar content knowledge and skills that students should demonstrate to meet the grade level or high school course standards have been paired. These pairings have been organized into tables and are sequenced by the 2014 academic standards. The 2005 content indicators that do not match 2014 content have been placed at the end of each table.

The academic standards in this document are not sequenced for instruction and do not prescribe classroom activities; materials; or instructional strategies, approaches, or practices. The *Crosswalks for the 2005 South Carolina Science Academic Standards and the 2014 South Carolina Academic Standards and Performance Indicators for Science,* is not a curriculum.

GRADE 4 SCIENCE CROSSWALK DOCUMENT

(* The 2005 content indicators that do not match 2014 content have been placed at the end of each table.)

2005	2014	Comments
Standard (Science & Engineering Practices)		
4-1: The student will demonstrate an understanding of scientific inquiry, including the processes, skills, and mathematical thinking necessary to conduct a simple scientific investigation.	**4.S.1:** The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.	In 2005 this standard and these indicators were referred to as "scientific inquiry"
Conceptual Understanding		
	4.S.1A. The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.	
Performance Indicators		
4-1.3 Summarize the characteristics of a simple scientific investigation that represent a fair test (including a question that identifies the problem, a prediction that indicates a possible outcome, a process that tests one manipulated variable at a time, and results that are communicated and explained).	**4.S.1A.1** Ask questions that can be (1) answered using scientific investigations or (2) used to refine models, explanations, or designs.	
	4.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.	This is a new expectation in 2014 standards
4-1.1 Classify observations as either quantitative or qualitative. **4-1.2** Use appropriate instruments and tools (including a compass, an anemometer, mirrors, and a prism) safely and accurately when conducting simple investigations. **4-1.3** Summarize the characteristics of a simple scientific investigation that represent a fair test (including a question that identifies the problem,	**4.S.1A.3** Plan and conduct scientific investigations to answer questions, test predictions and develop explanations: (1) formulate scientific questions and predict possible outcomes, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate	Identification of variables is a new skill in the 2014 standards.

a prediction that indicates a possible outcome, a process that tests one manipulated variable at a time, and results that are communicated and explained). **4-1.7** Use appropriate safety procedures when conducting investigations.	form. Use appropriate safety procedures.	
4-1.4 Distinguish among observations, predictions, and inferences. **4-1.6** Construct and interpret diagrams, tables, and graphs made from recorded measurements and observations.	**4.S.1A.4** Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support explanations, claims, or designs.	Using informational text is a new skill in 2014 standards.
4-1.5 Recognize the correct placement of variables on a line graph.	**4.S.1A.5** Use mathematical and computational thinking to (1) express quantitative observations using appropriate English or metric units, (2) collect and analyze data, or (3) understand patterns, trends and relationships between variables.	
4-1.6 Construct and interpret diagrams, tables, and graphs made from recorded measurements and observations.	**4.S.1A.6** Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.	
	4.S.1A.7 Construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.	Constructing arguments to support claims is a new skill in the 2014 standards.
	4.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4) support explanations, claims, or designs. Communicate observations and explanations using the conventions and expectations of oral and written language.	This is a new expectation in 2014 standards
Conceptual Understanding		

	4.S.1B. Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.	
	Performance Indicators	
	4.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.	Constructing devices and designing solutions is a new skill in the 2014 standards.

2005	2014	Comments
	Standard (Earth Science)	
4-4: The student will demonstrate an understanding of weather patterns and phenomena.	**4.E.2:** The student will demonstrate an understanding of the water cycle and weather and climate patterns.	
	Conceptual Understanding	
	4.E.2A. Earth's atmosphere is a mixture of gases, including water vapor and oxygen. The movement of water, which is found almost everywhere on Earth including the atmosphere, changes form and cycles between Earth's surface and the air and back again. This cycling of water is driven by energy from the Sun. The movement of water in the water cycle is a major pattern that influences weather conditions. Clouds form during this cycle and various types of precipitation result.	
	Performance Indicators	
	4.E.2A.1 Obtain and communicate information about some of the gases in the atmosphere (including oxygen, nitrogen, and water vapor) to develop models that exemplify the composition of Earth's atmosphere where weather takes place.	This is a new expectation in 2014 standards
4-4.1 Summarize the processes of the water cycle (including evaporation, condensation, precipitation, and runoff).	**4.E.2A.2** Develop and use models to explain how water changes as it moves between the atmosphere and Earth's surface during each phase of the water cycle (including evaporation, condensation, precipitation, and runoff).	
	Conceptual Understanding	
	4.E.2B. Scientists record patterns in weather conditions across time and place to make predictions about what kind of weather might occur next. Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over long periods of	

	time. Some weather conditions lead to severe weather phenomena that have different effects and safety concerns.	
	Performance Indicators	
4-4.2 Classify clouds according to their three basic types (cumulus, cirrus, and stratus) and summarize how clouds form. **4-4.3** Compare daily and seasonal changes in weather conditions (including wind speed and direction, precipitation, and temperature) and patterns. **4-4.5** Carry out the procedures for data collecting and measuring weather conditions (including wind speed and direction, precipitation, and temperature) by using appropriate tools and instruments. **4-4.6** Predict weather from data collected through observation and measurements.	**4.E.2B.1** Analyze and interpret data from observations, measurements, and weather maps to describe patterns in local weather conditions (including temperature, precipitation, wind speed/direction, relative humidity, and cloud types) and predict changes in weather over time.	This indicator alignment recognizes the cloud types and shifts from collection and comparison to analysis and interpretation.
4-4.4 Summarize the conditions and effects of severe weather phenomena (including thunderstorms, hurricanes, and tornadoes) and related safety concerns.	**4.E.2B.2** Obtain and communicate information about severe weather phenomena (including thunderstorms, hurricanes, and tornadoes) to explain steps humans can take to reduce the impact of severe weather phenomena.	
	4.E.2B.3 Construct explanations about regional climate differences using data from the long-term weather conditions of the region**.**	This indicator is new content in the 2014 standards.

2005	2014	Comments
	Standard (Earth Science)	
4-3: The student will demonstrate an understanding of the properties, movements, and locations of objects in the solar system.	**4.E.3:** The student will demonstrate an understanding of the locations, movements, and patterns of stars and objects in the solar system.	
	Conceptual Understanding	
	4.E.3A. Astronomy is the study of objects in our solar system and beyond. A solar system includes a sun, (star), and all other objects that orbit that sun. Planets in our night sky change positions and are not always visible from Earth as they orbit our Sun. Stars that are beyond the solar system can be seen in the night sky in patterns called constellations. Constellations can be used for navigation and appear to move together across the sky because of Earth's rotation.	
	Performance Indicators	
4-3.1 Recall that Earth is one of many planets in the solar system that orbit the Sun. **4-3.2** Compare the properties (including the type of surface and atmosphere) and the location of Earth to the Sun, which is a star, and the Moon. **4-3.3** Explain how the Sun affects Earth.	**4.E.3A.1** Develop and use models of Earth's solar system to exemplify the location and order of the planets as they orbit the Sun and the main composition (rock or gas) of the planets.	
	4.E.3A.2 Obtain and communicate information to describe how constellations (including Ursa Major, Ursa Minor, and Orion) appear to move from Earth's perspective throughout the seasons.	This indicator is new content in the 2014 standards.
4-3.8 Recognize the purpose of telescopes.	**4.E.3A.3** Construct scientific arguments to support claims about the importance of astronomy in navigation and exploration (including the use of telescopes, astrolabes, compasses, and sextants).	
	Conceptual Understanding	
	4.E.3B. Earth orbits around the Sun	

	and the Moon orbits around Earth. These movements together with the rotation of Earth on a tilted axis result in patterns that can be observed and predicted.	
	Performance Indicators	
4-3.6 Illustrate the phases of the Moon and the Moon's effect on ocean tides.	**4.E.3B.1** Analyze and interpret data from observations to describe patterns in the (1) location, (2) movement, and (3) appearance of the Moon throughout the year.	The focus of this indicator should not be on ocean tides.
4-3.5 Explain how the rotation of Earth results in day and night.	**4.E.3B.2** Construct explanations of how day and night result from Earth's rotation on its axis.	
4-3.7 Interpret the change in the length of shadows during the day in relation to the position of the Sun in the sky.	**4.E.3B.3** Construct explanations of how the Sun appears to move throughout the day using observations of shadows.	
4-3.4 Explain how the tilt of Earth's axis and the revolution around the Sun results in the seasons of the year.	**4.E.3B.4** Develop and use models to describe the factors (including tilt, revolution, and angle of sunlight) that result in Earth's seasonal changes.	

2005	2014	Comments
	Standard (Physical Science)	
4-5: The student will demonstrate an understanding of the properties of light and electricity.	**4.P.4:** The student will demonstrate an understanding of the properties of light and sound as forms of energy.	Sound moved from Grade 3 to Grade 4. Electricity & Magnetism moved from Grade 4 to Grade 3.
	Conceptual Understanding	
	4.P.4A. Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.	
	Performance Indicators	
4-5.2 Illustrate the fact that light, as a form of energy, is made up of many different colors.	**4.P.4A.1** Construct scientific arguments to support the claim that white light is made up of different colors.	
4-5.1 Summarize the basic properties of light (including brightness and colors).	**4.P.4A.2** Analyze and interpret data from observations and measurements to describe how the apparent brightness of light can vary as a result of the distance and intensity of the light source.	
4-5.3 Summarize how light travels and explain what happens when it strikes an object (including reflection, refraction, and absorption). **4-5.4** Compare how light behaves when it strikes transparent, translucent, and opaque materials.	**4.P.4A.3** Obtain and communicate information to explain how the visibility of an object is related to light.	
4-5.3 Summarize how light travels and explain what happens when it strikes an object (including reflection, refraction, and absorption).	**4.P.4A.4** Develop and use models to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption) using evidence from observations.	
4-5.4 Compare how light behaves when it strikes transparent, translucent, and opaque materials.	**4.P.4A.5** Plan and conduct scientific investigations to explain how light behaves when it strikes transparent, translucent, and opaque materials.	
	Conceptual Understanding	
	4.P.4B. Sound, as a form of energy, is produced by vibrating objects and has specific properties including	Sound is a new topic to Grade 4.

	pitch and volume. Sound travels through air and other materials and is used to communicate information in various forms of technology.	
	Performance Indicators	
	4.P.4B.1 Plan and conduct scientific investigations to test how different variables affect the properties of sound (including pitch and volume).	This is a new expectation in 2014 standards
	4.P.4B.2 Analyze and interpret data from observations and measurements to describe how changes in vibration affects the pitch and volume of sound.	This is a new expectation in 2014 standards
	4.P.4B.3 Define problems related to the communication of information over a distance and design devices or solutions that use sound to solve the problem.	This is a new expectation in 2014 standards

<u>These standards have moved to Grade 3, but should be taught in Grade 4 for the 2015-16 school year.</u>

*4-5.5 Explain how electricity, as a form of energy, can be transformed into other forms of energy (including light, heat, and sound).

*4-5.6 Summarize the functions of the components of complete circuits (including wire, switch, battery, and light bulb).

*4-5.7 Illustrate the path of electric current in series and parallel circuits.

*4-5.8 Classify materials as either conductors or insulators of electricity.

*4-5.9 Summarize the properties of magnets and electromagnets (including polarity, attraction/repulsion, and strength).

*4-5.10 Summarize the factors that affect the strength of an electromagnet.

2005	2014	Comments
	Standard (Life Science)	
4-2: The student will demonstrate an understanding of the characteristics and patterns of behavior that allow organisms to survive in their own distinct environments.	**4.L.5:** The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.	
	Conceptual Understanding	
	4.L.5A. Scientists have identified and classified many types of plants and animals. Each plant or animal has a unique pattern of growth and development called a life cycle. Some characteristics (traits) that organisms have are inherited and some result from interactions with the environment.	
	Performance Indicators	
4-2.1 Classify organisms into major groups (including plants or animals, flowering or nonflowering plants, and vertebrates [fish, amphibians, reptiles, birds, and mammals] or invertebrates) according to their physical characteristics.	**4.L.5A.1** Obtain and communicate information about the characteristics of plants and animals to develop models which classify plants as flowering or nonflowering and animals as vertebrate or invertebrate.	
	4.L.5A.2 Analyze and interpret data from observations and measurements to compare the stages of development of different seed plants.	This indicator is new content for the 2014 standards.
	4.L.5A.3 Develop and use models to compare the stages of growth and development in various animals.	This indicator is new content for the 2014 standards.
4-2.4 Distinguish between the characteristics of an organism that are inherited and those that are acquired over time.	**4.L.5A.4** Construct scientific arguments to support claims that some characteristics of organisms are inherited from parents and some are influenced by the environment.	
	Conceptual Understanding	
	4.L.5B. Plants and animals have physical characteristics that allow them to receive information from the environment. Structural adaptations within groups of plants and animals allow them to better survive and reproduce.	
	Performance Indicator	

4-2.3 Explain how humans and other animals use their senses and sensory organs to detect signals from the environment and how their behaviors are influenced by these signals.	**4.L.5B.1** Develop and use models to compare how humans and other animals use their senses and sensory organs to detect and respond to signals from the environment.	
	4.L.5B.2 Construct explanations for how structural adaptations (such as the types of roots, stems, or leaves; color of flowers; or seed dispersal) allow plants to survive and reproduce.	Plant adaptations are new content for 2014 standards.
4-2.5 Explain how an organism's patterns of behavior are related to its environment (including the kinds and the number of other organisms present, the availability of food and other resources, and the physical characteristics of the environment).	**4.L.5B.3** Construct explanations for how structural adaptations (such as methods for defense, locomotion, obtaining resources, or camouflage) allow animals to survive in the environment.	

*4-2.2 Explain how the characteristics of distinct environments (including swamps, rivers and streams, tropical rain forests, deserts, and the polar regions) influence the variety of organisms in each.
*4-2.6 Explain how organisms cause changes in their environment.

CONTENT SUPPORT GUIDE
FOR GRADE FOUR
2014 SOUTH CAROLINA ACADEMIC STANDARDS AND PERFORMANCE INDICATORS FOR SCIENCE

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SOUTH CAROLINA DEPARTMENT OF EDUCATION

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INTRODUCTION

Local districts, schools and teachers may use this document to construct standards-based science curriculum, allowing them to add or expand topics they feel are important and to organize content to fit their students' needs and match available instructional materials. The support document includes essential knowledge, extended knowledge, connections to previous and future knowledge, and assessment recommendations.

FORMAT OF THE CONTENT SUPPORT GUIDE

The format of this document is designed to be structurally uniformed for each of the academic standards and performance indicators. For each, you will find the following sections--

- **Standard**
  - This section provides the standard being explicated.
- **Conceptual Understanding**
  - This section provides the overall understanding that the student should possess as related to the standard. Additionally, the conceptual understandings are novel to the *2014 South Carolina Academic Standards and Performance Indicators for Science*.
- **Performance Indicator**
  - This section provides a specific set of content with an associated science and engineering practice for which the student must demonstrate mastery.
- **Assessment Guidance**
  - This section provides guidelines for educators and assessors to check for student mastery of content utilizing interrelated science and engineering practices.
- **Previous and Future Knowledge**
  - This section provides a list of academic content along with the associated academic standard that students will have received in prior or will experience in future grade levels. Please note that the kindergarten curriculum support document does not contain previous knowledge. Additionally, although the high school support document may not contain future knowledge, this section may list overlapping concepts from other high school science content areas.
- **Essential Knowledge**
  - This section illustrates the knowledge of the content contained in the performance indicator for which it is fundamental for students to demonstrate mastery.
- **Extended Knowledge**
  - This section provides educators with topics that will enrich students' knowledge related to topics learned with the explicated performance indicator.
- **Science and Engineering Practices**

This section lists the specific science and engineering practice that is paired with the content in the performance indicator. Educators should reference the chapter on this specific science and engineering practice in the *Science and Engineering Practices Support Guide.*

GRADE 4 SCIENCE CONTENT SUPPORT GUIDE

Standard
4.E.2: The student will demonstrate an understanding of the water cycle and weather and climate patterns.

Conceptual Understanding
4.E.2A. Earth's atmosphere is a mixture of gases, including water vapor and oxygen. The movement of water, which is found almost everywhere on Earth including the atmosphere, changes form and cycles between Earth's surface and the air and back again. This cycling of water is driven by energy from the Sun. The movement of water in the water cycle is a major pattern that influences weather conditions. Clouds form during this cycle and various types of precipitation result.

Performance Indicator
4.E.2A.1 Obtain and communicate information about some of the gases in the atmosphere (including oxygen, nitrogen, and water vapor) to develop models that exemplify the composition of Earth's atmosphere where weather takes place.

Assessment Guidance
The objective of this indicator is to *obtain and communicate information* about some of the gases in the atmosphere to *develop models* that exemplify the composition of Earth's atmosphere where weather takes place. Therefore, the primary focus of assessment should be for students to *obtain and evaluate* informational texts to *generate and answer questions* about atmospheric gases and then to develop models that support and exemplify the understanding of the composition of the earth's atmosphere. This could include, but is not limited to students analyzing informational texts and then creating a 2-D or 3-D model of the atmosphere with written or oral explanations of the gases found in atmosphere where weather takes place.

In addition to *obtaining and communicate information*, students should *ask questions; develop and use models; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; construct devices or design solutions.*

Previous and Future Knowledge
- 6.E.2A.1; H.E.5A.1 – Properties of the Atmosphere

Essential Knowledge
It is essential for students to know that Earth's atmosphere is the layer of gases that surrounds the planet and makes conditions on Earth suitable for living things.

The earth's atmosphere is divided into layers. Nitrogen makes up more than 3/4 of what we consider to be "air' and oxygen makes up most of the rest, but a small amount of carbon dioxide, water vapor, and other gases are also found in the atmosphere. The layer closest to the earth is where weather takes place. Water vapor (water in the form of a gas) is located in this layer.

Extended Knowledge
- Know the names of the layers, exact distance between each layer or the temperature of the layers.
- The chemistry of the different gas particles (such as H_2 is an element, and CO_2 is a compound). Carbon dioxide is also found in the atmosphere.

- Compare the properties of pure air with air containing particulate matter and unnatural gases, polluted air.
- Understand the carbon cycle and photosynthesis as related to carbon dioxide.

Science and Engineering Practices
S.1.A.8

Standard
4.E.2: The student will demonstrate an understanding of the water cycle and weather and climate patterns.

Conceptual Understanding
4.E.2A. Earth's atmosphere is a mixture of gases, including water vapor and oxygen. The movement of water, which is found almost everywhere on Earth including the atmosphere, changes form and cycles between Earth's surface and the air and back again. This cycling of water is driven by energy from the Sun. The movement of water in the water cycle is a major pattern that influences weather conditions. Clouds form during this cycle and various types of precipitation result.

Performance Indicator
4.E.2A.2 Develop and use models to explain how water changes as it moves between the atmosphere and Earth's surface during each phase of the water cycle (including evaporation, condensation, precipitation, and runoff).

Assessment Guidance
The objective of this indicator is to *develop and use models* to explain how water changes as it moves between the atmosphere and Earth's surface during each phase of the water cycle. Therefore, the primary focus of assessment should be for students to *construct 2-D drawings/diagrams and 3-D models* or use simulations to investigate how water changes form and cycles between Earth's surface and the air, and back again. This could include but is not limited to students developing an illustration or model of the water cycle, and use this model or illustration to explain what happens to water as it moves through each phase of the water cycle.

In addition to *developing and using models*, students should *ask questions; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous and Future Knowledge
- 6.E.2A.3 – Water cycle parts and properties
- H.E.6A.2 – Water cycle as a form of energy transfer

Essential Knowledge
It is essential for students to know that water changes form and then cycles between Earth's surface to the atmosphere and back again. The components of the water cycle process include:
Evaporation
- Liquid water on Earth becomes a gas, called water vapor, as part of the air through the process of evaporation.
- The process of evaporation results from the Sun's heat energy.

Condensation

- Condensation happens in the air as water vapor changes back to droplets of water. Clouds form as a result of condensation; dew also forms from condensation, but the water droplets condense directly onto a surface such as grass, a car, or glass.
- The process of condensation results from the cooling of the air temperature.

Precipitation

- After condensation occurs (allowing for the forming of clouds), any form of water that falls from the clouds is called precipitation (rain, snow, sleet, or hail).
- Snow, sleet, and hail result from freezing temperatures in the air inside of clouds; rain forms when the air temperature is above freezing.

Runoff

- If precipitation falls on land surfaces, it attempts to return to the ocean or lakes as runoff.

Extended Knowledge

- The process of transpiration from plants
- The movement of water through the groundwater system
- The methods of formation of hail, sleet, or snow

Science and Engineering Practices

S.1.A.2

Standard

4.E.2: The student will demonstrate an understanding of the water cycle and weather and climate patterns.

Conceptual Understanding

4.E.2B. Scientists record patterns in weather conditions across time and place to make predictions about what kind of weather might occur next. Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over long periods of time. Some weather conditions lead to severe weather phenomena that have different effects and safety concerns.

Performance Indicator

4.E.2B.1 Analyze and interpret data from observations, measurements, and weather maps to describe patterns in local weather conditions (including temperature, precipitation, wind speed/direction, relative humidity, and cloud types) and predict changes in weather over time.

Assessment Guidance

The objective of this indicator is to *analyze and interpret data* from observations, measurements, and weather maps to describe and predict changes in weather. Therefore, the primary focus of assessment should be for students to *analyze and interpret* data from informational texts, observations, measurements, and weather maps to reveal patterns and construct meanings from analyzing weather data, which will lead to predicting changes in weather over time. This could include, but is not limited to students creating a weather journal by making observations and taking measurements of temperature, precipitation, wind speed/direction, humidity, and cloud types. With their weather journal they will then analyze the data and then be able to predict what changes will happen over time.

In addition to *analyzing and interpreting data*, students should *ask questions; develop and use models; plan and carryout investigations; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous and Future Knowledge

- K.E.3A.1 – Describe local weather conditions to see patterns in weather
- 2.E.2A.1 – Describe local weather conditions based on data
- 6.E.2B.1 – Predict local weather conditions based on data
- H.E.5A.3 – Predict local weather conditions based on data regarding air masses, pressure systems and frontal boundaries

Essential Knowledge

It is essential for students to carry out procedures for collecting and measuring weather conditions in order to understand daily weather conditions. Weather data must be collected and read accurately using appropriate instruments:

Wind Speed

- Wind speed is measured with an *anemometer* as the wind causes the cups to spin.
- As the cups spin, the anemometer counts how many times they spin in a given period of time.
- The more turns, the faster the wind speed.
- An anemometer measures wind speed in kilometers and miles per hour.

Wind Direction

- Wind direction is determined with a *weather vane*.
- Wind direction is described by the direction from which the wind is blowing.

Precipitation

- Amount of precipitation is measured in a *rain gauge*.
- Markings on the side show how much rain has fallen.
- A rain gauge measures rainfall in centimeters or inches.

Temperature

- Air temperature is measured using a *thermometer*.
- The scale may be read in degrees Fahrenheit or Celsius.

It is essential for students to know that using data collected through daily or long term observations and measurements, and patterns in weather can be seen. Weather predictions are based on qualitative (data that can be observed, but not measured) and quantitative (data that can be measured) collected data; they are not just guesses.

- Some weather signs can be seen by looking at clouds.
- Changes in wind speed or wind direction can indicate storms or temperature changes.
- Meteorologists interpret information from a variety of sources and use those sources to make predictions. The information they use is shown on a weather map.
- Weather maps may show large masses of warm or cold moving air. Lines between the air masses are called *fronts*.
    - When a *warm front* passes over an area, the air temperature increases.
    - When a *cold front* passes over an area, the air temperature decreases.
- Data related to temperature and precipitation can also be found on a weather map.

NOTE TO TEACHER: This may be an appropriate opportunity for students to use a line plot to show collected weather data and/or convert weather measurements between units in the metric system (precipitation from cm to mm, number of days at a certain temperature, etc.).

Extended Knowledge

- Students can make or use any of these instruments: sling psychrometer, barometer, or hygrometer.

- Know how to read weather map data related to air pressure, how fronts form, how the air masses move in each type of front, stationary or occluded fronts, how to interpret station models, or how to track a hurricane from data.

Science and Engineering Practices
S.1.A.4

Standard
4.E.2: The student will demonstrate an understanding of the water cycle and weather and climate patterns.

Conceptual Understanding
4.E.2B. Scientists record patterns in weather conditions across time and place to make predictions about what kind of weather might occur next. Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over long periods of time. Some weather conditions lead to severe weather phenomena that have different effects and safety concerns.

Performance Indicator
4.E.2B.2 Obtain and communicate information about severe weather phenomena (including thunderstorms, hurricanes, and tornadoes) to explain steps humans can take to reduce the impact of severe weather phenomena.

Assessment Guidance
The objective of this indicator is to *obtain and communicate information* about severe weather so humans can take steps to reduce the impact of the phenomena. Therefore, the primary focus of the assessment should be for students *to obtain information* from texts, observations, and discussions to *generate and answer questions, and understand the phenomenon* knowing that the weather conditions associated with severe weather are different for each type of storm. These conditions have different effects and there are safety concerns associated with each condition. This could include, but is not limited to students creating a digital publication of the safety measures related to each type of severe weather.

In addition to *obtaining and communicating information*, students should *ask questions; develop and use models; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; construct devices or design solutions.*

Previous/Future Knowledge
- K.E.3A.4 – Weather impacts humans
- 2.E.2A.4 – Explain severe weather phenomenon and why safety precautions are necessary
- H.E.5A.5 – Explain severe weather formation based on evidence of meteorological conditions.

Essential Knowledge
It is essential for students to know that the weather conditions associated with severe weather are different for each type of storm. These conditions have different effects and there are safety concerns associated with each condition. Three types of severe weather include:
Thunderstorm
- A severe storm with lightning, thunder, heavy rain and strong winds.
- Some thunderstorms produce hail.
- Some examples of the effects of thunderstorms may be that heavy rains cause flooding, lightning can cause fires, and strong winds can blow over trees or power lines.

Tornado

- A funnel-shaped cloud that comes down from a storm cloud with winds spinning at very high speeds.
- Some examples of the effects of tornadoes may be that high winds damage and/or destroy buildings, trees, power-lines, and crops.

Hurricane

- A large storm that forms over warm ocean water with very strong winds that blow in a circular pattern around the center, or eye, of the storm.
- Some examples of the effects of hurricanes may be that high winds can blow over trees, power lines, and even buildings; heavy rain can cause flooding; the storm waves and rise in sea level at the beach cause massive flooding and damage the coastal zone.

There are safety concerns related to these storms because of their conditions and effects. Some examples of these safety concerns may be:

- During a thunderstorm, stay inside if possible; stay out of the water; and do not stand under trees.
- During a tornado, find a safe place away from window; if you cannot find shelter lie flat in a ditch or other low place; and do not stay in your car.
- During a hurricane, board up windows in your house; stay away from windows; and move further inland if you are near the coast.

Extended Knowledge

- Specific knowledge of how storms form.

Science and Engineering Practices

S.1.A.8

Standard

4.E.2: The student will demonstrate an understanding of the water cycle and weather and climate patterns.

Conceptual Understanding

4.E.2B. Scientists record patterns in weather conditions across time and place to make predictions about what kind of weather might occur next. Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over long periods of time. Some weather conditions lead to severe weather phenomena that have different effects and safety concerns.

Performance Indicator

4.E.2B.3 Construct explanations about regional climate differences using data from the long term weather conditions of the region**.**

Assessment Guidance

The objective of this indicator is to *construct explanations* about regional climate differences using data from the long term weather conditions of the region. Therefore, the primary focus of assessment should be *constructing explanations* using evidence of weather conditions and patterns to make predictions based on weather data collected from scientific models or graphs, tables, and diagrams. This could include, but is not limited to students proposing an explanation to regional climate differences and supporting the claim using weather maps and data collection from satellite and radar images.

In addition to *constructing explanations*, students should *ask questions; develop and use models; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous/Future Knowledge

- K.E.3A.2; 2.E.2A.2 – Seasonal weather patterns over time
- 6.E.2B.3 – Solar energy affects climate
- 6.E.2B.4 – Explain how climate is determined
- H.E.5A.6 – Climate is caused by global circulation
- H.E.5A.7; H.E.5A.8 – Climate change & human responsibility

Essential Knowledge

It is essential for students to know weather conditions and patterns can be predicted based on weather data collected from various sources.

Direct Observations and Measurements

- Basic weather conditions can be observed and/or measured using instruments or obtained from meteorologists at national weather data collection sites.
- In order to make weather predictions, the data should be collected on a regular basis over a period of time.
- This allows for the development of patterns in weather conditions from the analysis of the data.
- For example, a hurricane's path can be predicted using data on its position over time (plotted on a hurricane tracking map), thereby allowing meteorologists to make predictions concerning the possible warnings to land areas in the hurricane's path.

Weather maps

- Weather maps can help predict weather patterns by indicating high or low pressure systems, movement of air masses and fronts, or temperature ranges.
- Station models from specific locations provide information that can also be used to predict weather patterns.
- Information found on a station model can include cloud cover, temperature (85°F), wind direction and speed, precipitation (* - snow, ● – rain).

Satellites

- Satellite images are used for seeing cloud patterns and movements.
- For example, hurricane clouds and movement can be observed using satellite images.

Radar

- Radar images can be used to detect cloud cover, rainfall or storm location, intensity, and movement, as well as the potential for severe weather (for example, hurricanes or tornadoes).

Extended Knowledge

- Know how to draw weather maps or isobar or isotherm lines.
- Identify other information found on a station model such as the types of clouds, dew point, types of precipitation (other than snow or rain), or change in barometric pressure.

Science and Engineering Practices

S.1.A.6

Standard

4.E.3: The student will demonstrate an understanding of the locations, movements, and patterns of stars and objects in the solar system.

Conceptual Understanding
4.E.3A. Astronomy is the study of objects in our solar system and beyond. A solar system includes a sun, (star), and all other objects that orbit that sun. Planets in our night sky change positions and are not always visible from Earth as they orbit our Sun. Stars that are beyond the solar system can be seen in the night sky in patterns called constellations. Constellations can be used for navigation and appear to move together across the sky because of Earth's rotation.

Performance Indicator
4.E.3A.1 Develop and use models of Earth's solar system to exemplify the location and order of the planets as they orbit the Sun and the main composition (rock or gas) of the planets.

Assessment Guidance
The objective of this indicator is to *develop and use models* to explain the location and order of Earth's solar system, and the main composition of the planets. Therefore, the primary focus of assessment should be for students to *develop and use models to understand phenomena, processes, and relationships; test devices or solutions, or communicate ideas* to others. This could include, but is not limited to students constructing 2-D drawings/diagrams and 3-D models that represent and explain the properties of the Earth, Moon, and Sun, the composition of the inner and outer planets, as well as the order of the planets as they orbit the Sun. This could also include students developing a model to demonstrate the order of the planets from the Sun, as well as well illustrate the composition of the planets.

In addition to *developing and using models*, students should *ask questions; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous/Future Knowledge
- 8.E.4A.1 – Position of the Sun in the universe
- 8.E.4B.1 – Characteristics and movement of objects in the solar system
- H.E.2B.1 – Properties of Earth and other planets
- H.E.2B.3 – Determine the motion of orbiting objects in the solar system

Essential Knowledge
It is essential for students to know that Earth is a planet that orbits around the Sun. There are also other planets that orbit the Sun; some are closer to the Sun than Earth, and others are farther away. Some are small, rocky planets like Earth unlike Earth.

Planets - Planets are bodies, natural satellites, that orbit the Sun, a star.
Earth - Earth is the third planet from the Sun in the solar system
Sun - The Sun is the name for the central star in our solar system.

The sequence of the named planets from the Sun outward is also part of this recall. It is also essential for students to know that even though the Sun, the Moon and Earth are all in the solar system, they have different properties.
Earth
- Earth has a rocky surface as a planet and also has water on it.
- It has an atmosphere of gases around it.
- It orbits millions of miles from the Sun as the third planet in the solar system.

Sun

- The Sun is a star, a large ball of glowing gases that is extremely hot.
- It does not have a rocky surface and its atmosphere glows and gives off light.
- It is located at the center of the solar system.
- Earth and other planets revolve around it.
- The Sun is a star that appears brighter because it is closer to Earth than other stars.

Moon

- The Moon is the natural satellite that orbits the Earth.
- It has a rocky, dusty surface with many craters and no water.
- It has no atmosphere.

The order of the planets is Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

Planet	**Surface Composition****
Mercury	Rock
Venus	Rock
Earth	Rock (solid and liquid water)
Mars	Rock (solid water)
Jupiter	Gas, liquid (hydrogen, helium)
Saturn	Gas, liquid (hydrogen, helium)
Uranus	Gas, liquid (hydrogen, helium, methane)
Neptune	Gas, liquid (hydrogen, helium, methane)

**Teacher Note: the performance indicator is interpreted as main surface composition.

Extended Knowledge

- Know specific data about each planet, for example, distance from sun, time of revolution or rotation.
- Name the planets with rings; identify the names of or number of moons a planet has.
- Order the planets by any characteristic other than their orbiting arrangement as they revolve around the Sun.
- Know more specific data about Earth compared to the Sun and the Moon, for example, time of revolution or rotation with this indicator.
- Know the nuclear process that takes place so that the Sun can produce heat and light.
- Know the types of radiation that the Sun gives off.

Science and Engineering Practices
S.1.A.2

Standard
4.E.3: The student will demonstrate an understanding of the locations, movements, and patterns of stars and objects in the solar system.

Conceptual Understanding
4.E.3A. Astronomy is the study of objects in our solar system and beyond. A solar system includes a sun, (star), and all other objects that orbit that sun. Planets in our night sky change positions and are not always visible from Earth as they orbit our Sun. Stars that are beyond the solar system can be seen in the night sky in patterns

called constellations. Constellations can be used for navigation and appear to move together across the sky because of Earth's rotation.

Performance Indicator
4.E.3A.2 Obtain and communicate information to describe how constellations (including Ursa Major, Ursa Minor, and Orion) appear to move from Earth's perspective throughout the seasons.

Assessment Guidance
The objective of this indicator is to *obtain and communicate information* to describe how constellations appear to move from Earth's perspective throughout the seasons. Therefore, the primary focus of assessment should be for students to evaluate informational texts, observations, and data collected about the constellations' apparent motion and then use this information to understand the phenomena and support their explanations. This could include but is not limited to students creating an observation journal describing where the North Star is and then it's relation to the major constellations listed. Students can then use this to support their understanding and explanation of apparent motion phenomena.

In addition to *obtaining and communicating information*, students should *ask questions; develop and use models; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; construct devices or design solutions.*

Previous/Future Knowledge
- 1.E.3A – Objects in the sky move in predictable patterns.
- 8.E.4.A.1 – Explain the distances between stars and galaxies
- H.E.2.A.2 – Classify stars and explain their life cycles.

Essential Knowledge
- A constellation is a group of visible stars that form a pattern when viewed from Earth. The pattern may take the shape of an animal, mythological creature, man, woman, or object such as a crown or compass.
- The stars we see in each constellation are very far away from us. They appear to be close to each other in the shape, but may be great distances apart in space.
- As the earth rotates on its axis, the constellations and stars in them appear to move across the sky. They do not move in space, but appear to move because the Earth is moving.
    - At the equator, the stars move in a straight line across the sky. They rise in the east and set in the west.
    - Near the poles, the stars appear to rotate in a circle in the sky and never set.
- People in the Northern Hemisphere do not see the same constellations as the people in the Southern Hemisphere.
- Constellations may be only visible during certain seasons due to the Earth's orbit around the sun. The earth may be on the far side of the sun (further away from those stars, making them appear below the horizon) if the constellation is not visible.
- There are three important constellations to know:
    - **Ursa Major** is also called "Great Bear" and is one of the largest constellations. It is easily visible in the spring night sky. It is best known because it contains the "big dipper," which looks like a ladle.
    - **Ursa Minor** means "Little Bear" in Latin and is commonly known as the Little Dipper. The North Star (Polaris) is located at the tip of the handle.

- **Orion** is visible during the winter night sky and is one of the most recognizable constellations – it contains some of the brightest stars that we can see and is named for the hunter from Greek mythology. Looking for the three stars that form a line in Orion's belt is the easiest way to locate the constellation in the night sky.

NOTE TO TEACHER: Polaris, the North Star, is useful for finding the Little Dipper in the sky. In the Northern Hemisphere, Polaris appears in the sky above the North Pole. As the Earth rotates around its axis, Polaris does not seem to move. The stars near it do not rise or set – they appear to rotate around Polaris.

Extended Knowledge

- Students do not need to know the names of the stars in the constellations unless they are needed to identify the constellation or its location in the sky.
- Students do not need to know information about nebulas or galaxies contained in the constellations.
- Students do not need to be able to identify constellations other than the ones listed.

Science and Engineering Practices

S.1.A.8

Standard

4.E.3: The student will demonstrate an understanding of the locations, movements, and patterns of stars and objects in the solar system.

Conceptual Understanding

4.E.3A. Astronomy is the study of objects in our solar system and beyond. A solar system includes a sun, (star), and all other objects that orbit that sun. Planets in our night sky change positions and are not always visible from Earth as they orbit our Sun. Stars that are beyond the solar system can be seen in the night sky in patterns called constellations. Constellations can be used for navigation and appear to move together across the sky because of Earth's rotation.

Performance Indicator

4.E.3A.3 Construct scientific arguments to support claims about the importance of astronomy in navigation and exploration (including the use of telescopes, astrolabes, compasses, and sextants).

Assessment Guidance

The objective of this indicator is to *construct scientific arguments to support claims* about the importance of astronomy in navigation and exploration. Therefore, the primary focus of assessment should be for students to *construct explanations* using scientific evidence and models and data communicated in graphs, tables, and diagrams about telescopes, astrolabes, compasses, and sextants and how they aid in the navigation and exploration of space. This could include, but is not limited to students researching the tools and technology and connect their findings to support how they are important to the navigation and exploration in astronomy.

Previous/Future Knowledge

- 1.E.3A.3 – Basic knowledge of how technology helps humans study the sun, moon, and stars.
- 8.E.4B.5 – Technology helps provide information about objects in the solar system and universe.
- HE.2A.5 – Advanced telescopes and computer modeling helps explore the universe.

Essential Knowledge

It is essential for students to know that telescopes, astrolabes, compasses, and sextants are tools that aid in the study of objects in outer space.

A telescope can gather more light than the eye, so it makes faint, faraway objects seem brighter and closer. Astronomers, scientist who study outer space, have special telescopes to collect kinds of light; this enables them to look deeper into our solar system.

An ***astrolabe*** is an ancient astronomical instrument for solving problems relating to time and the position of the Sun and stars in the sky. Ancient uses included, finding the time of a sunrise and a sunset, determining local time, given local latitude, locate and predict positions of the sun, moon, planet, and stars.

A ***compass*** is a navigational instrument that shows directions in a frame of reference that is stationary relative to the surface of the Earth. The frame of reference defines the four *cardinal directions* (or *points*) – north, south, east, and west. Intermediate directions are also defined. Usually, a diagram called a compass rose, which shows the directions (with their names usually abbreviated to initials), is marked on the compass. When the compass is in use, the rose is aligned with the real directions in the frame of reference, so, for example, the "N" mark on the rose really points to the north.

A ***sextant*** is an instrument used to measure the angle between any two visible objects. Its primary use is to determine the angle between a celestial object and the horizon which is an essential part of celestial navigation. Common uses of the sextant include sighting the sun at solar noon and sighting Polaris at night (in the Northern Hemisphere), to find one's latitude.

Extended Knowledge

- Know about the design of reflecting and refracting telescopes
- Construct or experience the use of a telescope.

Science and Engineering Practices
S.1.A.6

Standard
4.E.3: The student will demonstrate an understanding of the locations, movements, and patterns of stars and objects in the solar system.

Conceptual Understanding
4.E.3B. Earth orbits around the Sun and the Moon orbits around Earth. These movements together with the rotation of Earth on a tilted axis result in patterns that can be observed and predicted.

Performance Indicator
4.E.3B.1 Analyze and interpret data from observations to describe patterns in the (1) location, (2) movement, and (3) appearance of the Moon throughout the year.

Assessment Guidance
The objective of this indicator is to *analyze and interpret data* from observations to describe patterns in the location, movement, and appearance of the Moon. Therefore, the primary focus of assessment should be for students to *analyze and interpret data from observations to construct meaning and support explanations* in the understanding that the Moon appears to change shape, which we call phases. This could include, but is not

limited to students developing a Moon observation calendar that they use to construct the meaning of the Moon's phases based on the location of the Moon in regards to the Earth and Sun.

In addition to *analyzing and interpreting data*, students should *ask questions; develop and use models; plan and carryout investigations; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous and Future Knowledge

- 1.E.3 – Motion of the moon across the night sky
- 8.E.4 – Observable physical characteristics of the moon
- H.E.2 – Technical composition of the moon and its orbit in relation to other moons in the solar system

Essential Knowledge

It is essential for students to know that the Moon reflects light from the Sun and just like Earth, half of the Moon is always lit by the Sun.

- Because of the positions of the Sun, the Moon, and Earth relative to each other, the Moon appears to change shape.
- The amount of reflected light from the Moon that is seen from Earth determines its phase.

The changing shapes of the Moon are called ***phases***. There are four main phases:

- *New moon* – the entire half/side of the Moon facing Earth is dark.
- *Quarter moon* – half of the side of the Moon facing Earth is lit and the other half is dark. The Moon appears as a half circle; there are two quarter-moon phases in the cycle.
- *Full moon* – the entire half/side of the Moon facing Earth is lit and the Moon appears as a full circle.
- *Crescent moon* – a small section (less than a quarter moon) of the half/side of the Moon facing Earth is lit.

The change in the Moon's phases from new moon to new moon takes about four weeks, 29½ days.

*NOTE TO TEACHER: Students may see the Quarter moon name as Half moon. Also, this may be an appropriate opportunity for students to use a line plot or other graph(s) to show collected observational moon data and then interpret the plot.

Extended Knowledge

- Students do not need to know that the gravitational relationship between the Earth and Moon cause the tides.
- Students do not need to understand lunar eclipses.
- Students do not need to know information about the moon's composition or orbit.

Science and Engineering Practices

S.1.A.4

Standard

4.E.3: The student will demonstrate an understanding of the locations, movements, and patterns of stars and objects in the solar system.

Conceptual Understanding
4.E.3B. Earth orbits around the Sun and the Moon orbits around Earth. These movements together with the rotation of Earth on a tilted axis result in patterns that can be observed and predicted.
Performance Indicator
4.E.3B.2 Construct explanations of how day and night result from Earth's rotation on its axis.

Assessment Guidance
The objective of this indicator is to *construct explanations* of how day and night result from Earth's rotation on its axis. Therefore, the primary focus of assessment should be for students to *use scientific evidence and models to construct an explanation* of how Earth's rotation from west to east makes the Sun appear to rise in the east and set in the west, day resulting from the side of Earth facing the Sun, and night resulting from the of side of Earth not facing the Sun. This could include, but is not limited to students using a model to explain why the Sun appears to rise in the east and set in the west causing day and night on Earth.

In addition to *constructing explanations,* students should *ask questions; develop and use models; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous/Future Knowledge
- 1.E.3A.1 – Seasonal patterns of sunrise and sunset
- 8.E.4B.3 – Axial tilt causes seasons, length of day, and surface heating patterns
- H.E.5A.2 – Seasons as tilt and angle of solar incidence

Essential Knowledge
It is essential for students to know that:
- Earth *rotates* (spins) on its axis and completes one rotation in 24 hours.
- Earth rotates from west to east, therefore, the Sun appears to rise in the east and set in the west.
- Because of this rotation, only the side of Earth facing the Sun is lit and therefore experiences day; the side of Earth not facing the Sun experiences night.

Extended Knowledge
- Rotation of other planets.

Science and Engineering Practices
S.1.A.6

Standard
4.E.3: The student will demonstrate an understanding of the locations, movements, and patterns of stars and objects in the solar system.

Conceptual Understanding
4.E.3B. Earth orbits around the Sun and the Moon orbits around Earth. These movements together with the rotation of Earth on a tilted axis result in patterns that can be observed and predicted.

Performance Indicator
4.E.3B.3 Construct explanations of how the Sun appears to move throughout the day using observations of shadows.

Assessment Guidance
The objective of this indicator is to *construct explanations* of how the Sun appears to move throughout the day based on shadows. Therefore, the primary focus of assessment should be for students to *construct an explanation using scientific evidence and models, and conclusions from scientific investigations* that describes how shadows help show Earth's rotation based on the position and angle of the Sun. This could include, but is not limited to students using the Sun's position and their shadow's position throughout the day and explain why the shadow moves as the Sun rises and sets.

In addition to *constructing explanations,* students should *ask questions; develop and use models; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous/Future Knowledge
- 1.E.3A.4 – Effect of sunlight on Earth's surface.
- 1.P.2A.3 – Shadows change when the light source changes position.
- 8.E.4B.4 – Interactions between the Sun, Moon, and Earth cause Earth phenomena.

Essential Knowledge
It is essential for students to know that objects on Earth cast shadows that help show Earth's rotation. The angle of the Sun, low in the sky to higher in the sky, changes the length of the shadow cast behind an object.
- As Earth rotates, the Sun appears higher in the sky, and the shadows get shorter.
- In the morning, the Sun appears low in the sky, so objects cast long shadows.
- At noon, with the Sun overhead, objects cast short shadows or no shadow at all.
- In the evening, as Earth continues to rotate, and the Sun appears lower in the sky, the shadows get longer again.

Extended Knowledge
- Types of shadows cast, umbra, or penumbra.
- Make or interpret sundials.

Science and Engineering Practices
S.1.A.6

Standard
4.E.3: The student will demonstrate an understanding of the locations, movements, and patterns of stars and objects in the solar system.

Conceptual Understanding
4.E.3B. Earth orbits around the Sun and the Moon orbits around Earth. These movements together with the rotation of Earth on a tilted axis result in patterns that can be observed and predicted.

Performance Indicator
4.E.3B.4 Develop and use models to describe the factors (including tilt, revolution, and angle of sunlight) that result in Earth's seasonal changes.

Assessment Guidance
The objective of this indicator is to *develop and use models* to describe the factors that result in Earth's seasonal changes. Therefore, the primary focus of assessment should be for students to *construct 2-D drawings/diagrams and 3-D models that represent the phenomena* of how the Earth's revolution and tilt create Earth's distinct seasons. This could include, but is not limited to students creating a model to illustrate Earth's seasons based on the Earth's tilt and revolution.

In addition to *developing and using models*, students should *ask questions; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous/Future Knowledge
- 1.E.3A.1 – Seasonal patterns of sunrise and sunset.
- 8.E.4B.3 – Axial tilt causes seasons, length of day, and surface heating patterns
- H.E.5A.2 – Seasons as tilt and angle of solar incidence

Essential Knowledge
It is essential for students to know that Earth has distinct seasons that result from the tilt of its axis and its revolution around the Sun.

Axis
Earth rotates around an imaginary straight line called an axis that runs through the planet's center.

Revolution

The movement of Earth as it makes an orbit around the Sun in one year.
- Earth revolves around the Sun one time each year in about 365 days.
- Earth has seasons because Earth's axis is tilted.
- Because of the tilt, the number of daylight hours changes throughout the year.
- As Earth revolves around the Sun, different parts of Earth get more sunlight.
- The tilt causes the hemispheres to point toward or away from the sun at different times during the Earth's revolution around the sun.
- When a hemisphere is tilted is toward the Sun, the season is summer; when the hemisphere is tiled away from the Sun, the season is winter.
- The two hemispheres have opposite seasons.
- The seasons do NOT depend on the distance of Earth from the Sun.

Seasons
- The effects on Earth due to the change in the amount of sunlight caused by the tilt of Earth's axis.
- Summer occurs when a hemisphere is tilted most toward the Sun
- Autumn, or spring occur when neither hemisphere is pointed directly toward or away from the Sun.
- Winter occurs when a hemisphere is tilted away from the Sun.

The sequence of the seasons during the calendar year is cyclical – winter, spring, summer, and fall occur in this sequence.

Extended Knowledge

- Students do not need to know that the earth's orbit is elliptical or information about aphelion and perihelion.
- Students do not need to know the degree of axial tilt.

Science and Engineering Practices
S.1.A.2

Standard
4.P.4: The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding:
4.P.4A Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicator
4.P.4A.1 Construct scientific arguments to support the claim that white light is made up of different colors**.**

Assessment Guidance
The objective of this indicator is to *construct scientific arguments* to support the claim that white light is made up of different colors**.** Therefore, the primary focus of assessment should be for students to *construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts* to explain that white light can be separated into energy of many colors (visible spectrum) by a prism. This could include, but is not limited to students conducting investigations in which they use the prism tool to separate white light into the visible spectrum. Students use the data from their observations to support the claim that white light is made up of different colors.

In addition to constructing scientific arguments, students should *ask questions; develop and use models; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous and Future Knowledge

- 8.P.3A.5 – Color is a result of the properties of light waves as they strike an object.
- H.P.3F.1 – Light is made up of particles interacting as a wave.

Essential Knowledge
It is essential for students to construct scientific arguments explaining that light is a form of energy and is made of many colors.
Energy

- *Energy* is the ability to make something move, happen, or change.

Colors

- Light, or "white light", is made up of all colors of light mixed together.

- If white light is passed through a *prism*, it can be separated into light of different *colors.*
- The colors are red, orange, yellow, green, blue, indigo and violet.
- These are the colors seen in a rainbow
- The different colors of light revealed when white light is passed through a prism are called the *spectrum*.
- These colors are related to the different amounts of energy in white light.

*SCIENTIFIC TOOLS used to construct scientific arguments that support the claim provide evidence that white light is made up of different colors (prism, flashlight)

Extended Knowledge

- Light energy moves in waves
- Each color of the rainbow has a different wavelength
- Astronomers spread starlight into a spectrum to study the specific colors of light

NOTE: The sun makes rainbows when white sunlight passes through rain drops

Science and Engineering Practices
S.1.A.7

Standard
4.P.4: The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding
4.P.4A Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicator
4.P.4A.2 Analyze and interpret data from observations and measurements to describe how the apparent brightness of light can vary as a result of the distance and intensity of the light source.

Assessment Guidance
The objective of this indicator is to *analyze and interpret data* from observations and measurements to describe how the apparent brightness of light can vary as a result of the distance and intensity of the light source. Therefore, the primary focus of assessment should be for students to *analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to reveal patterns and construct meaning, or support explanations, claims, or designs* to demonstrate that one basic property of light is brightness. Students should also explain how bright a light source appears depends on the amount of light a source gives off (*intensity*) and the distance of the light. This could include, but is not limited to students finding meaning in data from drawings and photographs that depict light sources at different distances and intensity.

In addition to analyzing and interpreting data, students should *ask questions; develop and use models; plan and carryout investigations; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous and Future Knowledge

- 8.P.3A.2 – Properties of waves
- H.P.3F.2 – Behavior of light waves

Essential Understanding

It is essential for students to *analyze and interpret data* that demonstrates the basic property of light and its brightness.

Brightness

- *Brightness* is the amount of light the eye receives from a source.
- How bright a light source appears to be depends on the amount of light a source gives off (*intensity*), and the distance of the light source.
- The closer the source of the light is, the greater the intensity or degree of brightness.
- The greater the distance the source of the light is, the lesser the intensity or brightness.

*SCIENTIFIC TOOLS used to make observations to describe the brightness of light (flashlight, tape measure, meter stick, candle, matches, lighter)

NOTE TO TEACHER: This may be an appropriate opportunity for students to convert distance measurements between units in the metric system from large units to smaller units.

Extended Knowledge

- Brightness can be described in words such as dim, bright, and brilliant.

Science and Engineering Practices

S.1.A.4

Standard

4.P.4: The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding:

4.P.4A Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicator

4.P.4A.3 Obtain and communicate information to explain how the visibility of an object is related to light.

Assessment Guidance

The objective of this indicator is to *obtain and communicate information* to explain how the visibility of an object is related to light. Therefore, the primary focus of assessment should be for students to *obtain and evaluate informational texts, observations, data collected or discussions to generate and answer questions, understand phenomena, develop models, and support explanations, claims, or designs. Students should describe observations and explanations using the conventions and expectations of oral and written language to communicate* that an object's visibility is dependent on the amount of light given off by the object, or reflected by the object. This could include, but is not limited to students obtaining information from scientific text, observations, and an investigation to construct a model that illustrates how light is necessary for humans to see objects.

In addition to obtaining and communicating information, students should *ask questions; develop and use models; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; construct devices or design solutions.*

Previous and Future Knowledge

- 1.P.2A.1 – Light makes objects visible
- 8.P.3A.3 –Behavior of waves
- H.P.3F.2 – Behavior of light

Essential Understanding

It is essential for students to be able to obtain information and communicate that an object's visibility is dependent on the amount of light given off by the object, or reflected by the object.

Visible

- In order for an object to be visible, it must either give off its own light (be a source of light) or it must *reflect* light.
- The Sun, a candle flame, or a flashlight (light sources) gives off visible light.
- Reflection allows objects to be seen that do not produce their own light.
- When light strikes an object, some of the light reflects off of the object and can be detected by eyes.
- For example, the Moon and many objects reflect light in order to be seen.

*SCIENTIFIC TOOLS used to explain how the visibility of an object is related to light (flashlight, candle, matches, lighter, mirrors)

Extended Knowledge

- Identify wavelengths or frequencies of light

Science and Engineering Practices

S.1.A.8

Standard

4.P.4: The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding:

4.P.4A: Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicator

4.P.4A.4 Develop and use model to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption) using evidence from observations.

Assessment Guidance

The objective of this indicator is to *develop and a use a model* to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption). Therefore, the primary focus of assessment should be for students to *understand or represent phenomena, processes, and relationships; test devices or*

solutions, or communicate ideas to others that light travels in a straight line until it strikes objects, then reflects, refracts or absorbs. This could include, but is not limited to students constructing 3D models and simulations to investigate the phenomena of reflection, refraction and absorption, and then using observations as evidence to explain each phenomenon.

In addition to developing and using a model, students should *ask questions; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous and Future Knowledge

- 1.P.2A.2 – Light behavior when shined on different objects
- 1.P.2A.5 – Light behavior when shined on a mirror
- 8.P.3A.3 – Behavior of waves – reflection, refraction, absorption
- 8.P.3A.5 – Color as a property of light reflection

Essential Knowledge

It is essential for students to *develop and use models* demonstrating that light travels in a straight line away from the light source. It can travel through transparent material and empty space. The way that light reacts when it strikes an object varies with the object.

Reflection

- When light is *reflected,* it bounces back from a surface.
- Reflection allows objects to be seen that do not produce their own light.
- When light strikes a smooth, shiny object, it is reflected so that an image can be seen. For example, a mirror or a pool of water will reflect (bounce back) an image very similar to the object.

Refraction

- When light is refracted it passes from one type of transparent material to another, and changes direction. For example, when light travels through a magnifying glass, it changes direction, and we see a larger, magnified view of the object.
- When a straw is viewed in water, light passes from the water to the air causing the path of the light to bend. When the light bends, the straw appears distorted (bent or broken)

Absorption

- When light is *absorbed* it does not pass through or reflect from a material. It remains in the material as another form of energy.

Seeing Color

- The light that is reflected by an object determines the color(s) of that object. Color is NOT caused by the absorption of light by an object.
- For example, a red object reflects red colors of light and absorbs all other colors.
- The color black is seen when all of the colors of light are absorbed.
- The color white is seen when all of the colors of light are reflected.

*SCIENTIFIC TOOLS used to create models to describe how light travels and interacts when it strikes an object (mirror, magnifier, prism, flashlight)

Extended Knowledge

- Absorbed light turns into heat energy

- The angles of reflection and refraction are different from each other
- Pigments of light mix to form various colors

Science and Engineering Practices
S.1.A.2

Standard
4.P.4: The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding
4.P.4A Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicator
4.P.4A.5 Plan and conduct scientific investigations to explain how light behaves when it strikes transparent, translucent, and opaque materials.

Assessment Guidance
The objective of this indicator is to *plan and conduct scientific investigations* to explain how light behaves when it strikes transparent, translucent, and opaque materials. Therefore, the primary focus of assessment should be for students *to plan and conduct scientific investigations to answer questions, test predictions, and develop explanations. Students should formulate scientific questions and predict possible outcomes, identify materials, procedures, and variables; select and use appropriate tools or instruments to collect qualitative and quantitative data, and record and represent data in an appropriate form* in order to explain how light behaves when it strikes different materials. Based on prior knowledge and student generated questions, students use provided materials to plan and conduct investigations that test how light behaves when it strikes transparent, translucent, and opaque materials. Qualitative data is recorded and organized in the appropriate format and used to answer questions, test predictions and develop explanations.

In addition to planning and conducting scientific investigations, students should *ask questions; develop and use models; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous and Future Knowledge
- 1P.2A.2 – Light behavior when shined on an object
- 1P.2A.4 – Light behavior when shined on a mirror
- 8.P.3A.3 – Properties of waves (reflection, refraction, absorption)
- 8.P.3A.5 – Color as absorption of light
- H.P.3F.2 – Interaction between visible light & objects

Essential Knowledge
It is essential for students to *plan and conduct scientific investigations* that explain how light behaves differently when it strikes different types of materials.

Transparent

- A *transparent* material allows light to pass through it.
- Objects can be seen clearly when viewed through transparent materials.
- Air, glass, and water are examples of materials that are *transparent*.

Translucent

- A *translucent* material allows some of the light to pass through it.
- Objects either scatters or absorbs light that strikes it.
- Objects appear as blurry shapes when viewed through translucent materials.
- Waxed paper and frosted glass are examples of materials that are *translucent*.

Opaque

- An *opaque* material does not allow light to pass through. Light is either reflected from or absorbed by an opaque material.
- Opaque objects block light, and cast a shadow.
- Wood, metals, and thick paper are examples of materials that are *opaque*.

*SCIENTIFIC TOOLS used to create investigate how light behaves when it strikes transparent, translucent, and opaque materials (glass beaker, plastic beaker, flashlight, prism, or any other appropriate materials)

Extended Knowledge

- The interaction of light waves with different materials makes them transparent, translucent, or opaque.

Science and Engineering Practices

S.1.A.3

Standard

4.P.4: The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding

4.P.4B Sound, as a form of energy, is produced by vibrating objects and has specific properties including pitch and volume. Sound travels through air and other materials and is used to communicate information in various form of technology.

Performance Indicator

4.P.4B.1: Plan and conduct scientific investigations to test how different variables affect the properties of sound (including pitch and volume).

Assessment Guidance

The objective of this indicator is to *plan and conduct scientific investigations* to test how different variables affect the properties of sound (including pitch and volume). Therefore, the primary focus of assessment should be for students to *plan and conduct scientific investigations to answer questions, test predictions, and develop explanations. Students should formulate scientific questions and predict possible outcomes, identify materials, procedures, and variables; select and use appropriate tools or instruments to collect qualitative and quantitative data, and record and represent data in an appropriate form* in order to test different variables of pitch and volume of sound. This could include, but is not limited to students carrying out investigations to test sound devices or variables such as string length, thickness and tension to affect pitch.

In addition to planning and conducting scientific investigations, students should *ask questions; develop and use models; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous and Future Knowledge

- 8.P.3A.2 – Wave properties (frequency, amplitude, wavelength, speed)
- H.P.3D.2 – Resonance
- H.P.3D.3 – Doppler effect
- H.P.3D.4 – Wave properties (including period, velocity, and energy)

Essential Knowledge

It is essential for students to plan and conduct scientific investigations that test sound vibrations that move through matter. These vibrations are back and forth movements that occur very quickly.

Vibration

- Vibrations can be transferred from one material to another causing that material to move back and forth.
- Vibrations of materials causing sound can travel through solids, liquids, and gases, but they cannot travel through empty space where there are no particles of matter to move back and forth.
- Sound moves better through some materials than others. For example, the sound of water filling a bathtub sounds louder under the water, moving through the liquid, than above the water, moving through the air.

Sound can have different pitches and volumes, as follows:

Pitch

- The *pitch* of a sound is how high or low it is. For example, an average dog growling produces a lower pitch than an average bird song, or a tuba can play lower pitches than a flute.
- There are several physical properties of the vibrating material that affect the resulting pitch of the sound. Changing these properties will change the pitch the object produces when vibrating. These are a few such properties:
    - *Thickness:*
        - A vibrating object with a *greater thickness* will produce a *lower pitch* than a vibrating object with a lesser thickness. For example, a thicker string will produce a lower pitch when plucked than the pitch a thinner string will produce.
        - Thinner string or wires vibrate *faster* than thicker strings or wires.
    - *Length:*
        - A vibrating object with a *greater length* will produce a *lower pitch* than a vibrating object with a lesser length. For example, a longer string will produce a lower pitch when plucked than the pitch a shorter string will produce.
        - Shorter objects vibrate *faster* than longer objects.
    - *Tension:*
        - Tension is the tightness of an object, for example, a tightly stretched rubber band or string.
        - A vibrating object under *greater tension* will produce a *higher pitch* than a vibrating object under lesser tension. For example, stretching a rubber band as much as possible and plucking it will produce a higher pitch than if the rubber band is under less tension.
        - Objects under greater tension vibrate faster than objects under less tension.

Volume

- *Volume* is the loudness or softness of a sound. For example, the sound of a person yelling is a louder volume than the sound of a person whispering – even if the pitch remains the same.
- There are several physical properties of the vibrating material that affect the resulting volume of the sound. Changing these properties will change the volume the object produces when vibrating. These are a few such properties:
    - *Force:*
        - Exerting a *larger force* on a vibrating object will produce a *louder volume* than exerting a lesser force.
        - The strength of the force alters the strength of the vibrations. For example, tapping a desk lightly produces a soft sound while hitting a desk hard produces a loud sound.
    - *Distance:*
        - If the sources of the sound are *farther away*, the volume of the sound is softer.
        - The closer the source of the sound, the louder the volume of the sound will be. For example, a person sounds louder if you are sitting right next to them than if you are sitting across the room from them.

*SCIENTIFIC TOOLS used to plan and conduct scientific investigations to test how different variables affect the properties of sound (glass beaker, tuning fork, musical instruments)

Extended Knowledge

- Sound waves are mechanical waves with three commonly measured attributes: wavelength, amplitude, and frequency.
- Pitch is related to the frequency of the sound wave. The frequency of a sound wave is like the speed of the sound wave.
- Volume is related to the amplitude of the sound wave. The amplitude of a sound wave is the tallness of the sound wave.

Science and Engineering Practices
S.1.A.3

Standard
4.P.4: The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding
4.P.4B Sound, as a form of energy, is produced by vibrating objects and has specific properties including pitch and volume. Sound travels through air and other materials and is used to communicate information in various form of technology.

Performance Indicator
4. P.4B.2: Analyze and interpret data from observations and measurements to describe how change in vibration affects the pitch and volume of sound.

Assessment Guidance
The objective of this indicator is to *analyze and interpret data* from observations and measurements to describe how change in vibration affects the pitch and volume of sound. Therefore, the primary focus of assessment should be for *students to analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to reveal patterns and construct*

meaning, or support explanations, claims, or designs that illustrate that changes in vibration alter the resulting pitch or volume of the sound in several different ways. This could include, but is not limited to students collecting and recording data from a series of investigations involving pitch of sound. Students analyze and interpret the data in order to reveal a pattern of the thickness, length, and tension of vibrating object alters the pitch of sound.

In addition to analyzing and interpreting data, students should *ask questions; develop and use models; plan and carryout investigations; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information; construct devices or design solutions.*

Previous and Future Knowledge

- 8.P.3A.2 – Wave properties (frequency, amplitude, wavelength, speed)
- H.P.3D.2 – Resonance
- H.P.3D.3 – Doppler effect
- H.P.3D.4 – Wave properties (including period, velocity, and energy)

Essential Knowledge

It is essential for students to analyze and interpret data demonstrating how changes in vibration alter the resulting pitch or volume of the sound in several different ways:

Pitch

The faster the vibration of the object, the higher the pitch of the sound; the slower the vibration of the object, the lower the pitch of the sound.

- *Thickness:* Thinner string or wires vibrate *faster* than thicker strings or wires, producing a *higher* pitch.
- *Length:* Shorter objects vibrate *faster* than longer objects, producing a *higher* pitch.
- *Tension:* Objects under greater tension vibrate faster than objects under less tension, producing a *higher* pitch.

Volume

The larger the vibration of the object, the louder the volume of the sound. The smaller the vibration of the object, the quieter the volume of the sound.

- *Force:* A greater force will produce a *larger* vibration, which will produce a *louder* sound.
- *Distance:* The closer the source of the vibration, the *larger* the vibration will be, so the sound will be *louder* at that location.

***SCIENTIFIC TOOLS** used to analyze and interpret data from observations and measurements to describe how change in vibration affects the pitch and volume of sound (*tuning fork, musical instruments)*

NOTE TO TEACHER: This may be an appropriate opportunity for students to use a line plot to show collected data and/or convert distance measurements between units in the metric system from large units to smaller units.

Extended Knowledge

- A sound wave with a greater frequency produces a higher pitch than a sound wave with a lesser frequency.
- A sound wave with larger amplitude produces a louder volume than a sound wave with smaller amplitude.

- The largeness or smallness of the wave – its amplitude – decreases as the wave travels over distances, in what is known at the Doppler Effect. This causes the volume of the sound wave to be different at different locations, even though it is the same sound wave.

Science and Engineering Practices
S1.A.4

Standard
4.P.4: The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding
4.P.4B Sound, as a form of energy, is produced by vibrating objects and has specific properties including pitch and volume. Sound travels through air and other materials and is used to communicate information in various form of technology.

Performance Indicator
4. P.4B.3: Define problems related to the communication of information over a distance and design devices or solutions that use sound to solve the problem.

Assessment Guidance
The objective of this indicator is to *define problems* related to the communication of information over a distance and *design devices or solutions* that use sound to solve the problem. Therefore, the primary focus of assessment should be for students to *ask questions to identify problems or needs, ask questions about the criteria and constraints of the devices or solutions, generate and communicate ideas for possible devices or solutions, build and test devices or solutions, determine if the devices or solutions solved the problem, and describe results* related to using sound to solve problems for communicating information over distances. This could include, but is not limited to students using prior knowledge acquired from investigations to define problems related to how volume and clarity of sound reduce over distance. They will then design and test devices to discover a solution for these problems.

In addition to defining problems to design devices or solutions, students should *ask questions; develop and use models; plan and carryout investigations; analyze and interpret data; use mathematical and computational thinking; engage in scientific argument from evidence; construct explanations; obtain, evaluate, and communicate information.*

Previous and Future Knowledge
- 8.P.3A.6 – Technological instruments extend human senses by transmitting and detecting waves.
- H.P.3F.6 – Waves are used to produce and transmit signals, and store and interpret information in technological devices.

Essential Knowledge
It is essential for students to identify problems and needs related to communication of information over a distance and to design devices to solve the problems. Students should define problems related to the communication of information over a distance. Possible problems include but are not limited to:
- The volume and clarity of sound decreasing and ceasing over a distance.

Design devices or solutions that use sound to solve the problem - to make a sound audible across a distance at which the same sound would not originally have been heard.

Students are expected to engage in the engineering design process by asking questions, designing devices, investigating possible solutions and repeating trials to determine which devices best solve the problem.

*SCIENTIFIC TOOLS used to describe how change in vibration affects the pitch and volume of sound (tuning fork, musical instruments)

Extended Knowledge

- Sound dissipates over a distance because amplitude decreases. Internal friction causes loss of clarity. Also caused by other waves adding or taking energy away by itself.
- A sound wave with larger amplitude produces a louder volume than a sound wave with smaller amplitude.

Science and Engineering Practices
S1.B.1

Standard
4.L.5 The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.

Conceptual Understanding
4.L.5A Scientists have identified and classified many types of plants and animals. Each plant or animal has a unique pattern of growth and development called a life cycle. Some characteristics (traits) that organisms have are inherited and some result from interactions with the environment.

Performance Indicator
4.L.5A.1 Obtain and communicate information about the characteristics of plants and animals to develop models which classify plants as flowering or non-flowering and animals as vertebrate or invertebrate.

Assessment Guidance
The objective of this indicator is to *obtain and communicate* information about the characteristics of plants and animals to develop models which classify them into groups. Therefore, the primary focus of assessment should be *to obtain and evaluate informational texts, observations, data collected, or discussions to 1) generate and answer questions, 2) understand phenomena, 3) develop models, or 4) support explanations, claims, or designs* to classify plants as flowering or non-flowering and animals as vertebrate or invertebrate, *and to communicate observations and explanations using conventions and expectations of oral and written language.* This could include, but is not limited to students collecting data about animal-like creatures and using that information to classify them as vertebrate or invertebrates.

In addition to *obtaining and communicating information*, students should *ask questions; plan and carry out investigations; analyze and interpret data; use mathematics and computational thinking; engage in argument from evidence; construct explanations; develop and use models*; and *construct devices or design solutions.*

Previous and Future Knowledge

- 1.L.5A.1 – Plant survival, growth, reproduction.
- 1.L.5A.2 – Stages of flowering plant development
- 2.L.5A.1 – Classification of animals
- 6.L.5B.3 – Structures and functions of flowering plants
- 6.L.5B.4 – Changes in environmental factors; growth and development of flowering plants.

- 6.L.4B.1 – Vertebrates and invertebrates

Essential Knowledge
Many organisms can be divided into groups based on their physical characteristics.
- Plants can be divided into flowering or non-flowering plants
- Animals can be divided into vertebrates and invertebrates

Plants are organisms that are made of many parts and are capable of producing their own food. Many different types of plants have been identified. Some plants produce flowers while other plants do not produce flowers.
Flowering plants
- Flowering plants make seeds within their flowers
- Some plants enclose their seeds within fruits that animals like to eat. Once animals eat the fruit, they distribute the seeds when they defecate.
- Examples are fruit trees (apples, plums), tomatoes, or beans.

Non-flowering plants
- Non-flowering plants are those plants that make seeds within cones or produce spores instead of seeds.
- Some examples of non-flowering plants can be pines, spruce, or cedar trees that produce cones. Ferns and mosses produce spores.

Animals are organisms that can be made of many parts, but cannot make their own food. They must get energy from eating plants or other animals. One way that animals are classified is according to whether or not they have a backbone.

Vertebrates
- Vertebrates are animals with backbones.
- Vertebrates can be further divided into fish, amphibians, reptiles, birds, and mammals.
- Vertebrates share other physical characteristics, for example, a protective skin covering, an inside skeleton, muscles attached to the bone, lungs or gills for obtaining oxygen from the air.

Invertebrates
- Invertebrates are animals without a backbone
- Some have a hard outer covering or a shell. Examples include insects, crabs, or clams.
- Others do not have a hard outer covering or shell. Examples include jellyfish, worms, shrimp, crayfish, sponges, sea stars, or snails.

Extended Knowledge
- Classification of invertebrates (sponges, segmented worms, worms, echinoderms, mollusks, and arthropods)
- Differentiation between vascular (ex: trees, flowers) and non-vascular (ex: moss, algae) plants
- Identification of parts of flowering and non-flowering plants.
- Scientific classification systems (kingdom, phylum, etc.)

Science and Engineering Practices
S.1.A.8

Standard
4.L.5 The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.

Conceptual Understanding
4.L.5A Scientists have identified and classified many types of plants and animals. Each plant or animal has a unique pattern of growth and development called a life cycle. Some characteristics (traits) that organisms have are inherited and some result from interactions with the environment.

Performance Indicator
4.L.5A.2 Analyze and interpret data from observations and measurements to compare the stages of development of different seed plants.

Assessment Guidance
The objective of this indicator is to *analyze and interpret* data from observations and measurements to *compare* the stages of development of different seed plants. Therefore, the primary focus of assessment should be *to analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to 1) reveal patterns and construct meaning or 2) support explanations, claims, or designs* in order to compare plants at different stages in their life cycle. This could include, but is not limited to students growing different plants from seeds over a period of time, while recording, analyzing, and interpreting data to reveal patterns that can be used to compare developmental stages of plants.

In addition to *analyzing and interpreting data*, students should to *ask questions; plan and carry out investigations; use mathematics and computational thinking; engage in argument from evidence; construct explanations; develop and use models; obtain, evaluate, and communicate information*; and *construct devices or design solutions.*

Previous and Future Knowledge
- 1.L.5A.2 – Stages of development of a flowering plant

Essential Knowledge
Plants have a unique pattern of growth and development called a life cycle. Examples of seeded plants include, but are not limited to conifers, redwood, oaks, etc.

Seed
- After pollination (spreading of pollen from flower to flower) occurs, seeds are produced and may be stored in fruits./
- Seeds contain tiny undeveloped plants and enough food for growth to start.
- Seeds need water and warmth to begin to grow *(germinate*)

Seedling
- Seedlings are the first sprouts from a seed.
- Seedlings produce the parts of the plant that will be needed for the adult plant to survive in its habitat
- Roots begin to grow and take in nutrients and water from the habitat
- The stem starts to grow towards light and the first leaves form on the stem
- Later, more leaves will form that help the plant make its food

Mature Plant
- Mature plants have the same structures (roots, stems, leaves) as seedlings, but in addition, they are able to reproduce using flowers or cones, which produce seeds.

NOTE TO TEACHER: This may be an appropriate opportunity for students to use a line plot or other graphs to show collected data and/or convert measurements between units in the metric system from large units to smaller units.

Extended Knowledge

- Parts and/or types of leaves
- Specific structures of flowers
- How seeds are produced
- Photosynthesis
- Plant adaptations

Science and Engineering Practices

S.1.A.4

Standard

4.L.5 The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.

Conceptual Understanding

4.L.5A Scientists have identified and classified many types of plants and animals. Each plant or animal has a unique pattern of growth and development called a life cycle. Some characteristics (traits) that organisms have are inherited and some result from interactions with the environment.

Performance Indicator

4.L.5A.3 Develop and use models to compare the stages of growth and development in various animals.

Assessment Guidance

The objective of this indicator is to *develop and use models* to compare the stages of growth and development in various animals. Therefore, the primary focus of assessment should be *to develop and use models to 1) understand or represent phenomena, processes, and relationships, 2) test devices or solutions, or 3) communicate ideas to others* about animals at different stages of their life cycles. This could include, but is not limited to students developing a model of the life cycle of a butterfly and a frog and then comparing the stages of growth and development in each animal.

In addition to *developing and using models*, students should be asked to *ask questions; plan and carry out investigations; analyze and interpret data; use mathematics and computational thinking; engage in argument from evidence; construct explanations; obtain, evaluate, and communicate information*; and *construct devices or design solutions.*

Previous and Future Knowledge

- 2.L.5A.3 – Stages of the development of animals

Essential Knowledge

The stages of growth and development (life cycle) are not the same for all animals.

- Some animals give birth to baby animals that look like small adults. As the babies grow, they change in size. Other changes may be color, shape, or type of covering. For example, horses give birth to babies that look like small horses. Chickens lay eggs that hatch babies that look like small chickens.

- Some animals begin as an egg and then undergo changes in their life cycle. These changes may be in appearance, color, shape, or growth of new bodily structures. These changes in form are called *metamorphosis*. For example, in a beetle, the stages of metamorphosis are called egg, larva, pupa, and adult. In a grasshopper, the stages of metamorphosis are egg, young (nymph), and adult

Animal Class	**Stages of Development**	**Examples**
Mammal	Young-Adult	dog, squirrel, human, whale (all have live birth)
Reptile	Egg-Young-Adult	snake, turtle, lizard, alligator
	Young-Adult	rattlesnake (live birth)
Amphibian	Egg-Young-Adult	frog, toad, salamander
Insect	Egg-Larva-Pupa-Adult	butterfly, beetle, housefly, mosquito
	Egg-Young-Adult	grasshopper, cockroach, praying mantis
Bird	Egg-Young-Adult	chicken, robin, hawk, duck
Fish	Young-Adult	guppies (live birth)
	Egg-Young-Adult	goldfish, catfish

*NOTE TO TEACHER: Specific descriptions of each class (mammals have fur, etc.) are contained in 2.L.5A.1.

Extended Knowledge
- animal adaptations for environments
- incomplete metamorphosis

Science and Engineering Practices
S.1.A.2

Standard
4.L.5 The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.

Conceptual Understanding
4.L.5A Scientists have identified and classified many types of plants and animals. Each plant or animal has a unique pattern of growth and development called a life cycle. Some characteristics (traits) that organisms have are inherited and some result from interactions with the environment.

Performance Indicator

4.L.5A.4 Construct scientific arguments to support claims that some characteristics of organisms are inherited from parents and some are influenced by the environment.

Assessment Guidance
The objective of this indicator is to *construct scientific arguments to support claims* that some characteristics of organisms are inherited from parents and the environment influences some. Therefore, the primary focus of assessment should be for students to *construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts* regarding how some characteristics of organisms are influenced by environmental factors such as temperature, nutrition, exposure to sunlight, disease, injury and living condition while other characteristics are inherited. This could include but is not limited to students observing pictures of arctic foxes in different seasons and being prompted to make a claim and provide evidence for their claim regarding when and why the fox's fur changes from brown to white.

In addition to *constructing scientific arguments from evidence*, students should be asked *to ask questions; plan and carry out investigations; analyze and interpret data; use mathematics and computational thinking; construct explanations; obtain, evaluate, and communicate information; develop and use models;* and *construct devices or design solutions.*

Previous and Future Knowledge
- 2.L.5A.1 – Animal classification by class/characteristics.
- 6.L.4B.1 – Support claims that all animals share common characteristics.
- 6.L.4B.2 – Structural adaptations for defense, resource obtainment, or movement.
- 7.L.4A.1; 7.L.4A.2 – Relationship between genes and characteristics and transmission from parent to offspring.
- 8.E.6B.1 – Genetic variations enable survivability.
- H.B.4A.1 – Genetic transmission from parent to offspring.

Essential Knowledge
Some characteristics of organisms are inherited from parents and some are influenced by the environment.

Physical Characteristics:
Some physical characteristics of organisms are passed from parents to their offspring (inherited).
- Inherited traits may help distinguish one organism from another.
- Some examples of animal characteristics may be type and color of body coloring, type and shape of sensory organs, or body structure.
- Some examples of plant characteristics may be shape of leaves, color of flowers, or type of fruit.

Some characteristics of organisms are influenced by environmental factors. These factors include: temperature, nutrition, exposure to sunlight, disease, injury and living conditions
- Traits influenced by the environment do not change the organism into another kind of organism. Traits influenced by the environment are not usually passed on to offspring.
- Temperature can change the size and thickness of a plant's leaves.
- Animals may experience a change in fur thickness in response to temperature fluctuations.
- Animals' coats may also change color in response to the seasons.
- A lack of nutrients may make plants and/or animals experience stunted growth and make them vulnerable to sickness.
- Injuries to plants and animals may produce scarring.

- Changes in the amount of sunlight may affect the size and growth rate of plants. It may also cause changes in skin color of humans and other animals.

Extended Knowledge
- Traits as a function of genetics
- Specific tropisms or dormancy in plants

Science and Engineering Practices
S.1.A.7

Standard
4.L.5 The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.

Conceptual Understanding
4.L.5B Plants and animals have physical characteristics that allow them to receive information from the environment. Structural adaptations within groups of plants and animals allow them to better survive and reproduce.

Performance Indicator
4.L.5B.1 Develop and use models to compare how humans and other animals use their senses and sensory organs to detect and respond to signals from the environment.

Assessment Guidance
The objective of this indicator is to *develop and use models* to compare how humans and other animals use their senses and sensory organs to detect and respond to signals from the environment. Therefore, the primary focus of assessment should be to *develop and use models to 1) understand or represent phenomena, processes, and relationships, 2) test devices or solutions, or 3) communicate ideas to others* about how humans and animals sense and respond to changes in their environment. This could include but is not limited to students developing visual models to communicate the cause and effect relationship between humans' and other animals' use of hearing to sense approaching danger and their responses to danger.

In addition to *developing and using models,* students should be asked to *ask questions; plan and carry out investigations; analyze and interpret data; use mathematics and computational thinking; engage in argument from evidence; construct explanations; obtain, evaluate, and communicate information*; and *construct devices or design solutions.*

Previous and Future Knowledge
- K.L.2A.4 – Senses and sensory organs (eyes, nose, ears, tongue, skin)
- 6.L.4B.3 – Detection and response to external stimuli

Essential Knowledge
Animals, including humans, have sensory organs that allow them to detect and respond to signals from the environment. After these signals are detected, the organism responds with certain behaviors. A *behavior* is a response to a change in the environment.

Senses tell animals what they need to know about their environment.
- Sensory organs are any part of the body that receives signals from the environment.

- They help to keep animals out of danger and enable them to find food and shelter.
- Many animals have the same type of sense organs as humans.

In general, every animal has the senses it needs for its own environment and way of life. However, some animals need different information about their environment to survive. They may have sharper senses than others. For example:

- Dogs have a very strong sense of smell
- Some animals like bats can use echolocation
- Many small mammals can see in very low light conditions
- Some aquatic animals use electric sensation
- Some migratory animals may be able to use magnetism from the Earth to navigate

*See the chart below

Senses	Signals Detected	Examples of Sensory Organs in Humans and Other Animals	Examples of Behaviors of Humans and Other Animals
Sight	detects colors, shapes, sizes, space/distance, light, movement	humans have eyes; other animals' eyes may differ in type, number, and location on the body	locate food or shelter; recognize objects or other organisms.
Hearing	receives vibrations, detects sound	humans have ears; other animals' hearing organs may differ in type, number, and location on the body	Locate food; sense danger to escape enemies; communication
Taste	detects flavors; humans detect salty, sweet, bitter, and/or sour tastes	humans have taste buds on tongues; other animals' taste organs differ in type and in location on the body	judge which foods are safe to eat
Smell	detects odors	humans have a nose; other animals' smelling organs differ in type and in location on the body	avoid danger; find food; recognize other organisms
Touch	detects shapes, size, temperature, texture, pain, vibrations, pressure	humans have a skin; other animals' touching organs differ in type and location on the body	identify food; react to dangerous situations; care for each other; communication

Extended Knowledge

- Anatomy of the structures of the five sensory organs in humans
- Functioning of the central nervous system

Science and Engineering Practices

Standard
4.L.5 The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.
Conceptual Understanding
4.L.5B Plants and animals have physical characteristics that allow them to receive information from the environment. Structural adaptations within groups of plants and animals allow them to better survive and reproduce.

Performance Indicator
4.L.5B.2 Construct explanations for how structural adaptations (such as the types of roots, stems, or leaves; color of flowers; or seed dispersal) allow plants to survive and reproduce.

Assessment Guidance
The objective of this indicator is to *construct explanations* for how structural adaptations allow plants to survive and reproduce. Therefore, the primary focus of assessment should be for students to *construct explanations using 1) scientific evidence and models, 2) conclusions from scientific investigations, 3) predictions based on observations and measurements, or 4) data communicated in graphs, tables, or diagrams* to show how plant structures (such as the types of roots, stems, or leaves; color of flowers; or seed dispersal) assist plants in meeting their needs for survival within their environment. This could include, but is not limited to students collecting data after observing the root growth of different varieties of plants and reasoning with their data to construct an explanation about how different types of roots help plants survive in a variety of habitats.

In addition to *constructing explanations,* students should *ask questions; plan and carry out investigations; analyze and interpret data; use mathematics and computational thinking; engage in argument from evidence; obtain, evaluate, and communicate information; develop and use models;* and *construct devices or design solutions.*

Previous and Future Knowledge
- K.L.2A.2 – Basic needs of plants.
- 1.L.5B.3 – Response of plants to environmental changes/stimuli.
- 6.L.4A.1 – Support claims that organisms exhibit certain behaviors

Essential Knowledge
Plants are adapted to their habitats so that their needs can be met. Some plants have special structural *adaptations* for meeting their needs in their particular habitat. Some examples of plant adaptations to conditions in their habitat may be:
Roots
- Roots take in water and nutrients from the habitat.
- They may also hold the plant in place and store food and water.
- Each variety of plant will survive where its roots' size, length, and spread are adapted to the habitat.
- Some examples of root adaptations may be:
    - Water lilies have long roots that can take in nutrients from the muddy bottom of ponds or lakes.
    - Cacti have roots that spread out close to the surface for living in dry habitats.
    - Carrots and dandelions have a large, thick root that is longer than its other roots. This long root helps the plant survive by reaching far underground to find water and to firmly anchor the plant.

Stems

- Stems move and store water and nutrients in the plant. Stems also provide support and protection for the plant. Some examples of stem adaptations may be:
    - Vines have stems that can climb and stick to various surfaces to ensure that the leaves are exposed to light.
    - Corn and sunflowers have stems that grow thick and strong but remain green and flexible so that they can grow toward the sun
    - Trees develop woody stems (and trunks) to support their size and provide protection against wind and physical damage during their long lifetime.
    - Cacti have thick stems that store water when the habitat does not provide it.
    - Some stems have thorns that provide protection

Leaves

- Leaves produce food for plants in the presence of light.
- Each variety of plant will survive where its leaf size, texture, thickness, and shape are adapted to the habitat.
- Some examples of leaf adaptations may be:
    - Water lilies develop wide leaves that allow them to float on the water to capture sunlight to make food.
    - Evergreen trees have leaves that are shaped like thin, waxy needles to protect them from freezing and from losing water.

Flowers

- Flowers often have special sizes, shapes, smells, or colors that attract organisms for pollination.
- The color of plant parts (fruits such as berries and petals) makes them attractive to some animals (birds and bees are attracted to the color and will pollinate).

Fruit

- Fruits are formed around the seed to protect it. Some examples of fruit adaptations may be:
    - Some fruits are moist and fleshy (tomatoes, grapes, or peaches). Fleshy fruits attract animals that eat them, helping to disperse the seeds.
    - Other fruits are dry and/or hard (coconuts, pecans, pea pods)

Seeds

- Some seeds begin to grow as soon as conditions allow for germination
- Because most seeds may not survive, a plant produces many seeds, which need to be *dispersed*, or carried away. Some seeds have hooks that allow them to attach to fur or clothes. Some seeds are able to float in water. Some seeds are light enough to be carried away by the wind. Other seeds are eaten by animals and deposited elsewhere.

Extended Knowledge

- Parts and types of leaves
- Specific structures of flowers
- How seeds are produced

Science and Engineering Practices

S.1.A.6

Standard

4.L.5 The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.

Conceptual Understanding
4.LB.5 Plants and animals have physical characteristics that allow them to receive information from the environment. Structural adaptations within groups of plants and animals allow them to better survive and reproduce.

Performance Indicator
4.L.5B.3 Construct explanations for how structural adaptations (such as methods for defense, locomotion, obtaining resources, or camouflage) allow animals to survive in the environment.

Assessment Guidance
The objective of this indicator is to *construct explanations* for how structural adaptations allow animals to survive in the environment. Therefore, the primary focus of assessment should be for students to *construct explanations using 1) scientific evidence and models, 2) conclusions from scientific investigations, 3) predictions based on observations and measurements, or 4) data communicated in graphs, tables, or diagrams* to explain how structures for defense, locomotion, obtaining resources, or camouflage affect an animal's ability to survive in its habitat. This could include but is not limited to students observing moths and frogs in their environments and using data collected from their observations to support claims about how animals use camouflage to survive.
In addition to *constructing explanations,* students should be asked to *ask questions; plan and carry out investigations; analyze and interpret data; use mathematics and computational thinking; engage in argument from evidence; obtain, evaluate, and communicate information; develop and use models;* and *construct devices or design solutions.*

Previous and Future Knowledge
- 2.L.5A.2 – Structures for seeing, hearing, grasping, protection, locomotion, and obtaining/using resources help animals survive
- 3.L.5B.2 – Changes in the environment cause plants and animals to respond in different ways
- 8.E.6B.1 – Biological adaptations enhance the probability of an animal's survival.

Essential Knowledge
Animals are adapted to their habitat so that their needs can be met. Some adaptations of animals can help them find food or water, protect them from danger, or help them survive when conditions in the environment change. These adaptations include:

Defense
- Some animals have physical adaptations to protect themselves from being hurt, killed, or eaten. These adaptations include quills, claws, fangs, or spraying scent glands and warning stripes in skunks. Giraffes have horns that allow them to spar with other animals.

Locomotion
- In order for animals to find the resources they need for food, shelter, or space, they must be able to move around.
- Animals have special structures for moving, depending on where they live.
    - Above ground: swinging (monkey tails), climbing and traction (squirrel claws), and flying (bird wings)
    - On the ground: crawling (webbed lizard feet), walking (dog paws, donkey hooves), or hopping (grasshopper legs)
    - In the water: floating (jellyfish), swimming (fish fins), or diving (dolphin and penguin flippers)
- Whiskers are used for feeling in many animals. For example, a fox uses its whiskers to determine if it

can move into a tight space or if there is enough space to move. Otters use their whiskers for the same purpose, but underwater.

Obtaining resources

- Animals have special structures used for obtaining and eating food.
    - For example, the beaks of birds are shaped according to the available food
    - Mouths of insects are often elongated to reach nectar within flowers
    - Teeth or claws are shaped in different ways depending on the type of food they can eat.

Camouflage

- Camouflage is a color or pattern that allows an animal to blend into its environment and protects it from being seen by its enemies or allows it to sneak up more easily on its food.
    - Tigers have vertical stripes that help them blend into the grassland areas in which they live.
    - The macaw uses its brightly colored feathers to hide among brightly colored plants in the rainforest.
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Extended Knowledge

- Behavioral adaptations of animals

Science and Engineering Practices

S.1.A.6