

SUPPORT GUIDE 3.0 FOR FOURTH GRADE

SOUTH CAROLINA ACADEMIC STANDARDS AND PERFORMANCE INDICATORS FOR SCIENCE

Molly M. Spearman
State Department of Education



SOUTH CAROLINA

DEPARTMENT OF EDUCATION

Table of Contents

Introduction to Standards	3
Academic Standards.....	3
The Profile of the South Carolina Graduate	4
The Science and Engineering Practices	5
Crosscutting Concepts	6
Deciphering the Standards	7
Core Areas	8
Acknowledgements.....	9
Introduction to Content Support Guide.....	10
4.E.2 - Earth Science: Weather and Climate	12
4.E.3 - Earth Science: Stars and the Solar System	25
4.P.4 - Physical Science: Forms of Energy - Light and Sound	46
4.L.5 - Life Science: Characteristics and Growth of Organisms	65
References.....	85

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.

As science educators we must take a 3 dimensional approach in facilitating student learning. By addressing content standards, science and engineering practices and crosscutting concepts, students are able to have relevant and evidence based instruction that can help solve current and future problems. For more information please see: <https://www.nap.edu/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts>.

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.

Profile of the South Carolina Graduate



World Class Knowledge

- Rigorous standards in language arts and math for career and college readiness
- Multiple languages, science, technology, engineering, mathematics (STEM), arts and social sciences

World Class Skills

- Creativity and innovation
- Critical thinking and problem solving
- Collaboration and teamwork
- Communication, information, media and technology
- Knowing how to learn

Life and Career Characteristics

- Integrity
- Self-direction
- Global perspective
- Perseverance
- Work ethic
- Interpersonal skills

Approved by SCASA Superintendents Roundtable and SC Chamber of Commerce
 SC Education Oversight Committee, SC State Board of Education, SC Department of Education,
 SC General Assembly, SC Council on Competitiveness, TransformSC, & SC Arts in Basic Curriculum
 Steering Committee

SCIENCE AND ENGINEERING PRACTICES

In addition to the academic standards, each grade level or high school course explicitly identifies *Science 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 https://ed.sc.gov/scdoe/assets/file/agency/ccr/Standards-Learning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf.

Support for the guidance, overviews of learning progressions, and explicit details of each SEP can be found in the Science and Engineering Support Document https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf.

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.

The link <http://www.nap.edu/read/13165/chapter/8> provides support from the framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (2012) that gives further guidance on each crosscutting concept.

1. **Patterns:** The National Research Council (2012) states that “observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them” (p. 84).
2. **Cause and Effect: Mechanism and Explanation:** The National Research Council (2012) states that “events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts” (p. 84).
3. **Scale, Proportion, and Quantity:** The National Research Council (2012) states that “in considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance” (p. 84).
4. **Systems and Systems Models:** The National Research Council (2012) states that “Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering” (p. 84).
5. **Energy and Matter:** Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems’ possibilities and limitations.
6. **Structure and Function:** The National Research Council (2012) states that “the way in which an object or living thing is shaped and its substructure determine many of its properties and functions” (p. 84).
7. **Stability and Change:** The National Research Council (2012) states that “For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study” (p. 84).

DECIPHERING THE STANDARDS

Kindergarten

Life Science: Exploring Organisms and the Environment

Standard K.L.2: The student will demonstrate an understanding of the effects of forces on the motion and stability of an object.

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).

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

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

- Earth Science: Weather and Climate
- Earth Science: Stars and the Solar System
- Physical Science: Forms of Energy – Light and Sound
- Life Science: Characteristics and Growth of Organisms

Acknowledgements

The South Carolina Academic Standards and Performance Indicators for Science included in this document were developed under the direction of Dr. David Mathis, Deputy Superintendent, Division of College and Career Readiness and Dr. Anne Pressley, Director, Office of Standards and Learning. The following South Carolina Department of Education (SCDE) staff members collaborated in the development of this document: Jeffrey Burden, Elementary Science Education Associate Office of Standards and Learning, Gwendolynn Shealy, Secondary Science Education Associate Office of Standards and Learning, Brenda Ponsard, Science Education Associate Office of Assessment.

The following SC Educators collaborated with the SCDE to revise the South Carolina Support Document, and their time, service, and expertise are appreciated.

Cathy Carpenter (Kershaw)
Ann Darr (Newberry)
Jennifer Dressel (Dorchester 2)
Edwin Emmer (Richland 2)
Dena Fender (Richland 2)
Ellen Fender (Colleton)
Rebecca Jackson (Dorchester 2)
Jessica Morton (Greenville)
Jenny Risinger (Greenwood)
Janet Rizer (Colleton)
Lynette A. Smith (York 3)
Shannon Stone (Horry)
Elisabeth Vella (Dorchester 2)
Dr. Pamela Vereen (Georgetown)

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

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 standard, conceptual understanding, performance indicator, science and engineering practices, crosscutting concepts, essential learning experiences, extended learning experiences, assessment guidelines, learning connections, and in some cases note to teacher.

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.

Science and Engineering Practices (SEPs)

- This section lists the specific science and engineering practice that are 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*.
- Educators have the freedom to enhance SEPs addressed during instruction.
- SEPs Support Guide

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Crosscutting Concepts (CCCs)

- Cross Cutting Concepts (<http://www.nap.edu/read/13165/chapter/8>) This link provides support from the Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (2012).
- Educators have the freedom to enhance CCCs addressed during instruction.

Essential Learning Experiences

- This section illustrates the knowledge of the content contained in the performance indicator for which it is fundamental for students to demonstrate mastery.

Note to Teacher

- If necessary or appropriate, this section provides additional instructional guidance.

Extended Learning Experiences

- This section provides educators with topics that will enrich students' knowledge related to topics learned with the explicated performance indicator.

Assessment Guidelines

- This section provides guidelines for educators and assessors to check for student mastery of content utilizing interrelated science and engineering practices.

Learning Connections

- 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.

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 Indicator	4.E.2A.1: <u>Obtain and communicate information</u> 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.
Science and Engineering Practice	4.S.1A.8: <u>Obtain and evaluate</u> 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. <u>Communicate</u> observations and explanations using the conventions and expectations of oral and written language.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Scale, Proportion, and Quantity Systems and System Models

Essential Learning Experiences:

It is essential that students obtain information from a variety of sources about the basic nature of the Earth’s atmosphere, about the basic nature layer of the atmosphere, the troposphere, where weather takes place, and about the basic composition of the troposphere with regard to the relative proportions of the following gases: nitrogen, oxygen, and water vapor.

It is essential that students use the information from different sources to develop models of the Earth’s atmosphere.

- The atmosphere is a layer of gases that surrounds the Earth that supports life.
- The troposphere is the layer of the atmosphere that is closest to the Earth’s surface.
 - The troposphere is where weather takes place.
 - The troposphere is where water vapor is present.
 - The troposphere is the layer of the atmosphere where humans live.
- The relative composition of the Earth’s atmosphere with regard to nitrogen (~78%), oxygen (~21%) and other gases (~1%) that include among them water vapor and carbon dioxide as well as very small amounts of other gases.

NOTE TO TEACHER: Teachers can use this opportunity to use pie charts and/or bar graphs to represent the composition of Earth’s atmosphere.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain information in order to model additional layers of the atmosphere.
- Students may model the relative composition of additional gases in the atmosphere beyond nitrogen, oxygen, and water vapor.
- Students may obtain information in order to model additional characteristics of the atmosphere (thickness of each layer, gases present, temperature, and altitude.)

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

[https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete 2014SEPsGuide_SupportDoc2_0.pdf](https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete%202014SEPsGuide_SupportDoc2_0.pdf)

Learning Connections	<p>Future Learning Connections (5-8):</p> <p>6.E.2A.1: Develop and use models to exemplify the properties of the atmosphere (including the gases, temperature and pressure differences, and altitude changes) and the relative scale in relation to the size of Earth.</p> <p>6.E.2A.2: Critically analyze scientific arguments based on evidence for and against how different phenomena (natural and human induced) may contribute to the composition of Earth’s atmosphere.</p>
-----------------------------	---

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 Indicator	4.E.2A.2: <u>Develop and use models</u> 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).
Science and Engineering Practice	4.S.1A.2: <u>Develop, use, and refine models</u> to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
Crosscutting Concepts	<p>The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6.</p> <p>Cause and Effect Scale, Proportion, and Quantity Systems and System Models Energy and Matter Stability and Change</p>

Essential Learning Experiences:

It is essential that students collect data about how adding and removing heat energy is related to how water changes states through the processes of evaporation, condensation, and precipitation and how water cycles between the Earth’s surface and the troposphere through evaporation, condensation, precipitation, and runoff through investigations and informational texts.

It is essential that students use the data collected from investigations and informational texts to develop models that illustrate the following:

- The Sun is the source of the heat energy that drives the water cycle.
- Water changes state through evaporation, precipitation, and condensation by the addition of or removal of heat energy.
- As heat energy is added to liquid water, it changes into water vapor gas and rises through the process of evaporation from water on the Earth’s surface in rivers, streams, lakes, and oceans.

- As heat energy is removed from water vapor, it condenses back into liquid water droplets that cling to dust particles in the air to form clouds. These water droplets may cling to solid surfaces near the ground to form frost or dew depending upon the temperature.
- When water droplets in the air become too heavy they fall as a result of gravity in the form of precipitation.
- The type of precipitation that forms (i.e.: rain, sleet, snow, hail) depends on the temperature and weather conditions under which it forms.
- Once precipitation reaches the ground, gravity causes water to flow downhill through rivers and streams into ponds, lakes, and oceans.

NOTE TO TEACHER: Students will use thermometers as they investigate the different processes involved in the water cycle.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may further investigate the specific ways the different types of precipitation form.
- Students may investigate how transpiration from plants is another element of the water cycle.
- Students may investigate how liquid water can move through the water cycle through groundwater in addition to runoff.
- Students may investigate how liquid water may become temporarily locked in underground aquifers instead of continuing to flow as part of the water cycle.
- Students may investigate how solid water ice may become temporarily locked in glaciers and ice sheets instead of continuing to melt and flow as part of the water cycle.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>1.E.4A.2: Develop and use models (such as drawings or maps) to describe patterns in the distribution of land and water on Earth and classify bodies of water (including oceans, rivers and streams, lakes, and ponds).</p> <p>2.P.3A.3: Conduct structured investigations to test how adding or removing heat can cause changes in solids and liquids.</p> <p>3.E.4A.2: Develop and use models to describe and classify the pattern distribution of land and water features on Earth.</p> <p>3.P.2A.1: Analyze and interpret data from observations and measurements to describe and compare the physical properties of matter (including length, mass,</p>
-----------------------------	---

temperature, and volume of liquids).

3.P.2A.2: Construct explanations using observations and measurements to describe how matter can be classified as a solid, liquid or gas.

3.P.2A.3: Plan and conduct scientific investigations to determine how changes in heat (increase or decrease) change matter from one state to another (including melting, freezing, condensing, boiling, and evaporating).

Future Learning Connections (5-8):

5.P.2A.1: Analyze and interpret data from observations and measurements of the physical properties of matter (including volume, shape, movement, and spacing of particles) to explain why matter can be classified as a solid, liquid or gas.

6.E.2A.3: Construct explanations of the processes involved in the cycling of water through Earth's systems (including transpiration, evaporation, condensation and crystallization, precipitation, and downhill flow of water on land).

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.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 Indicator	4.E.2B.1: <u>Analyze and interpret data</u> 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.
Science and Engineering Practice	4.S.1A.4: <u>Analyze and interpret data</u> 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.
Crosscutting Concepts	<p>The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6.</p> <p>Patterns Stability and Change</p>

Essential Learning Experiences:

It is essential that students collect the following weather data through the use of weather instruments, weather maps, and online weather data sources for their location on a daily basis:

- Temperature
 - Temperature is measured through the use of thermometers in units of degrees Fahrenheit (°F) or degrees Celsius (°C).
- Precipitation
 - Precipitation is a measure of the amount of rain, sleet, snow, or hail over a period of time.
 - Precipitation is measured using a rain gauge in units of inches or centimeters.
- Wind speed
 - Wind speed is measured using an anemometer in units of miles per hour and/or kilometers per hour.
- Wind direction
 - Wind direction is the measurement of the direction from which the wind is blowing (example: a northeast wind means the winds is blowing from the northeast direction).
 - Wind direction is determined using a wind vane.

- Relative humidity
 - Relative humidity is a measure of the relative amount of water vapor present in the air at a given time.
- Cloud types
 - Cloud type is a description of the specific types of clouds that are observed.
 - Cloud type can be an indication of current and future weather conditions.
 - Cloud cover is an observation of the relative amount of the sky that is obscured by clouds of different types. It is typically described using the following phrases:
 - Clear/Sunny indicates zero clouds or mostly cloud free
 - Mostly Clear/Mostly Sunny indicates minimal cloud cover
 - Partly Cloudy/Partly Sunny indicates approximately half of the sky is cloud covered
 - Mostly Cloudy indicates nearly all of the sky is cloud covered
 - Cloudy indicates the entire sky is cloud covered

It is essential that students collect this weather data continuously over the course of several weeks in order to have sufficient data to identify patterns and trends in weather conditions.

It is essential that students analyze and interpret the weather data they have collected in order to describe daily weather conditions, identify patterns among different weather data, and to predict weather conditions based on patterns and trends that can be observed in their data. Weather patterns and trends can include:

- Changes in temperature can be an indication of the approach of a warm or cold front, which might bring precipitation and/or storms.
- Precipitation and sometimes storms usually occurs as a warm or cold front moves through a region. Temperatures after a warm front moves through are generally warmer while temperatures after a cold front moves through are generally cooler.
- Temperatures that are unchanging along with clear skies are usually signs of stable weather conditions.
- Changes in humidity are usually signs of weather systems and precipitation.
- Warm air masses are typically more humid than cold air masses.
- Changes in wind speed and direction can indicate the approach of a warm or cold front and possible precipitation and/or storms.
- Cloud types can be indications of current and upcoming weather conditions.
 - Cirrus clouds are high and wispy and signal fair weather or an approaching warm front
 - Cumulus clouds are puffy with flat bottoms and signal fair weather.
 - However, when they are darker, they may signal rain or thunderstorms, as they develop into Cumulonimbus clouds (thunderheads).
 - Stratus clouds are spread over a large area and are layered. As these clouds thicken long periods of precipitation can occur over the area where the clouds are located.

It is essential that students collect, analyze, and interpret data from weather maps to identify weather conditions across an area as well as to identify the location of warm and cold fronts that

are indications of changes in weather and the approach of weather systems such as precipitation and possible storms. The following data is most commonly represented using weather maps:

- Temperature, usually presented as numerical data (°F in the United States) as well as bands of color.
- Precipitation, usually presented as numerical data (inches in the United States) as well as ranges of color indicating the amount and intensity of the precipitation.
- Warm and cold fronts, represented as red lines with half circles (warm fronts) or blue lines with triangles (cold fronts). Fronts can also be identified by looking at how temperatures differ on either side of the front boundary.

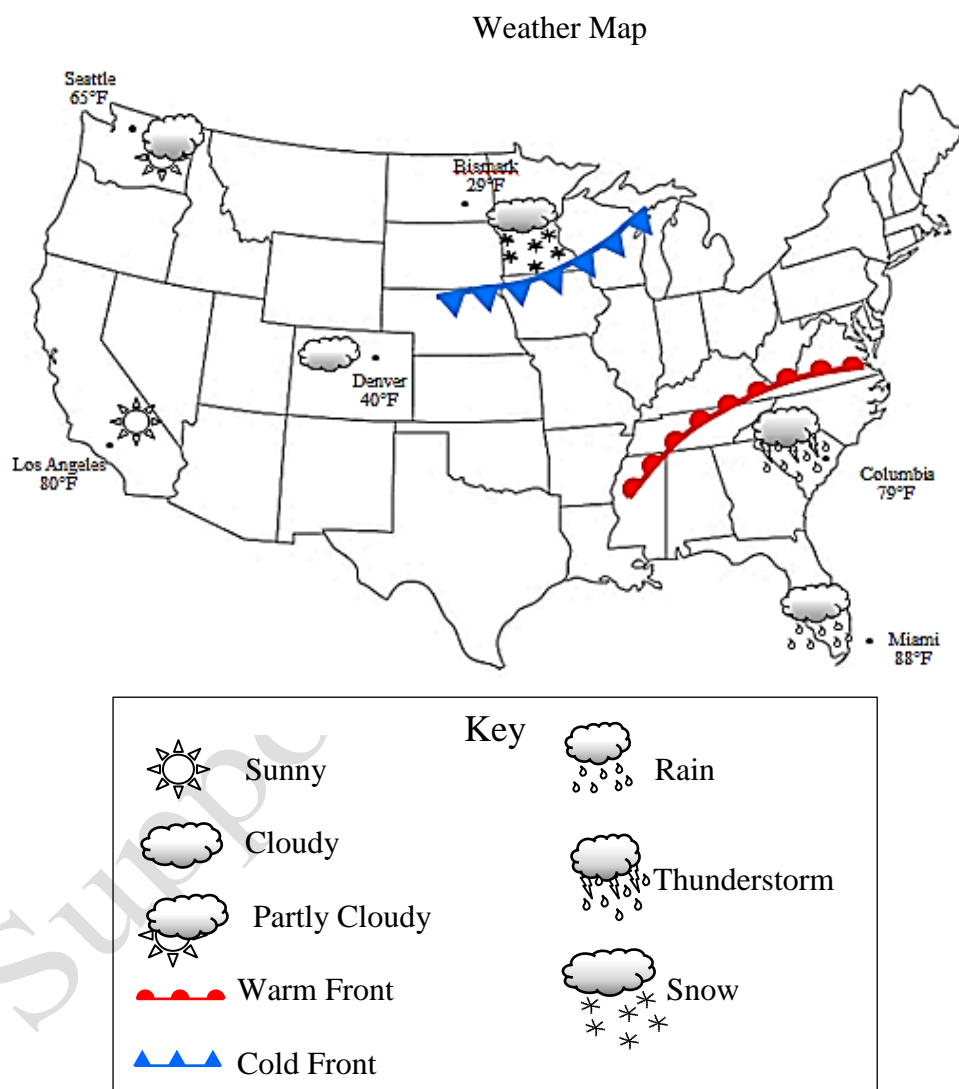


Figure 2. Weather map (SCDE, 2018).

NOTE TO TEACHER: Students will use the following tools to collect weather data: thermometers, wind vanes, anemometers, rain gauges, weather maps, and online weather data sources. This is an excellent opportunity for students to communicate data using line plots and bar graphs. Relative humidity is reported in terms of the percentage of water vapor the air can hold at its current temperature with higher percentages indicating greater humidity. When referencing wind speed, students should use standard and metric units.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain additional weather data about weather conditions not described above, such as barometric pressure.
- Students may collect additional weather data using a sling psychrometers, barometers, and hygrometers.
- Students may use and interpret weather maps to collect data about weather conditions not described above, including air pressure, air masses, stationary or occluded fronts, and the tracking severe weather events such as hurricanes.
- Students may use and interpret weather station models.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>K.E.3A.1: Analyze and interpret local weather condition data (including precipitation, wind, temperature, and cloud cover) to describe weather patterns that occur from day to day, using simple graphs and pictorial weather symbols.</p> <p>K.E.3A.2: Develop and use models to predict seasonal weather patterns and changes.</p> <p>2.E.2A.1: Analyze and interpret data from observations and measurements to describe local weather conditions (including temperature, wind, and forms of precipitation).</p> <p>2.E.2A.2: Analyze local weather data to predict daily and seasonal patterns over time.</p> <p>Future Learning Connections (5-8):</p> <p>6.E.2B.1: Analyze and interpret data from weather conditions (including wind speed and direction, air temperature, humidity, cloud types, and air pressure), weather maps, satellites, and radar to predict local weather patterns and conditions.</p> <p>6.E.2B.2: Develop and use models to explain how relationships between the</p>
-----------------------------	---

movement and interactions of air masses, high and low pressure systems, and frontal boundaries result in weather conditions and storms (including thunderstorms, hurricanes and tornadoes).

Support Document 3.0

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.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 Indicator	4.E.2B.2: <u>Obtain and communicate</u> information about severe weather phenomena (including thunderstorms, hurricanes, and tornadoes) to explain steps humans can take to reduce the impact of severe weather phenomena.
Science and Engineering Practice	4.S.1A.8: <u>Obtain and evaluate</u> 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. <u>Communicate</u> observations and explanations using the conventions and expectations of oral and written language.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect

Essential Learning Experiences:

It is essential that students obtain information from a variety of sources about different severe weather phenomena and their characteristics, including specific threats to both life and property associated with each of the following severe weather events:

- Thunderstorms: weather events that include rain, lightning and thunder
 - Severe storms that can produce the following dangerous conditions:
 - Heavy rain capable of causing flooding in low lying areas.
 - Strong winds capable of knocking down tree limbs, trees, power lines, and damaging homes and other structures.
 - Lightning capable of knocking out power, igniting fires, and electrocution.
 - Hail (pellets of ice) that can become large enough to damage property and cause injury.
 - Tornadoes can occur during intense thunderstorms storms, causing even greater damage.
- Hurricanes:
 - Tropic systems that typically form over warm water from June through November
 - Develop from tropical depressions and tropical storms
 - Mainly in the tropical Atlantic Ocean and Gulf of Mexico in the eastern US

- Hurricanes can produce the following dangerous conditions:
 - Very strong sustained winds (74 miles per hour or greater) along with even stronger gusts capable of knocking down tree limbs, trees, powerlines, and damaging or destroying homes and other structures.
 - Prolonged heavy rain capable of causing flooding in streams, ponds, and low lying areas.
 - Coastal flooding caused by the storm surge, water driven on shore by the hurricane's strong, sustained winds that can rise very quickly, flooding coastal areas and damaging or washing away buildings and property.
 - Tornadoes can occur during the intense storms associated with hurricanes, causing even greater damage.
- Tornadoes
 - Funnel-shaped, spinning clouds
 - Form at the base of cumulonimbus clouds and reach the ground with very strong winds
 - Extremely strong winds (73 miles per hour or greater) capable of knocking down tree limbs, trees, and powerlines and damaging or destroying buildings and property
 - Dust and debris in the spinning funnel-shaped cloud can damage property and cause injury and death

It is essential that students use the information from different sources to construct explanations for why people should take certain precautions when preparing for severe weather events based on the specific characteristics of each event, including the following:

- Thunderstorms: As a result of the dangerous condition during a thunderstorm, people should do the following:
 - Stay or go inside to avoid harm from flying debris, large hail, falling tree limbs, trees, or powerlines.
 - Avoid low lying areas prone to flooding.
 - Never take shelter under a tree.
 - Bring pets indoors.
 - Avoid downed power lines after a storm.
 - Avoid walking through floodwaters as they can be polluted and hide dangers (snakes, debris, power lines).
- Hurricanes: As a result of the dangerous conditions during a hurricane, people should do the following:
 - Track the approach of the hurricane several days in advance.
 - Make evacuation plans if living in an area prone to coastal flooding.
 - Prepare a hurricane evacuation kit in case of evacuation.
 - Board up windows to protect from strong winds and flying debris.
 - Prepare for the possibility of several days without power (stockpile at least 3 days of clean water, non-perishable food, batteries, and other necessary items for survival)
 - Stay indoors in a safe, sturdy structure as the hurricane moves through the area.
 - Bring pets indoors.
 - Avoid downed power lines after a storm.
 - Avoid walking through floodwaters as they can be polluted and hide dangers (snakes, debris, power lines).

- Tornadoes: As a result of the dangerous conditions during a tornado, people should do the following:
 - Monitor local radio and television weather reports during severe thunderstorms and hurricanes as tornadoes often occur during these severe weather events.
 - Stay indoors, away from windows, near the center of the building for example, inside windowless bathrooms, closets, or basements.
 - If outside, get indoors immediately. If that is not possible, lie flat in an open space. Never get inside a car to avoid a tornado.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain information to describe how thunderstorms, hurricanes, and tornadoes form.
- Students may obtain and communicate information about other severe weather events, their causes, characteristics, and precautions people should take, including floods, droughts, blizzards, etc.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

[https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete 2014SEPsGuide SupportDoc2 0.pdf](https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete%202014SEPsGuide%20SupportDoc2%200.pdf)

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>K.E.3A.4: Define problems caused by the effects of weather on human activities and design solutions or devices to solve the problem.</p> <p>2.E.2A.4: Obtain and communicate information about severe weather conditions to explain why certain safety precautions are necessary.</p> <p>Future Learning Connections (5-8):</p> <p>6.E.2B.2: Develop and use models to explain how relationships between the movement and interactions of air masses, high and low pressure systems, and frontal boundaries result in weather conditions and storms (including thunderstorms, hurricanes and tornadoes).</p>
-----------------------------	--

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.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 Indicator	4.E.2B.3: <u>Construct explanations</u> about regional climate differences using data from the long term weather conditions of the region.
Science and Engineering Practice	4.S.1A.6: <u>Construct explanations</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Cause and Effect Stability and Change

Essential Learning Experiences:

It is essential that students use various resources, including online weather data sources, regional weather maps, regional weather satellite and radar images, to collect long term weather data for different regions (both within the state and across the country).

- Students should be collecting data from different regions that they are collecting on a daily basis for their own local weather conditions (**4.E.2B.1**) in order to set up their comparisons.
- Satellite images can be used to observe cloud cover and track the motion of weather systems, such as fronts and hurricanes.
- Radar images can be used to observe cloud cover, location and intensity of precipitation, location and movement of weather systems, and severe weather phenomena.

It is essential that students analyze, organize, and interpret the weather data collected from different regions in the same manner they analyze and interpret their local weather data (**4.E.2B.1**) using maps, charts, and graphs, including looking for patterns and trends in the weather data over time.

It is essential that students use data collected and analyzed from different regions to construct explanations for how the long term weather in different areas compares with their local, long term weather. This includes using data and maps from areas to that explain:

- The latitude of a region (how far north or south a location is) can affect the average long term temperatures and types of precipitation in different areas.
- The distance from a large body of water, such as the Atlantic Ocean, Pacific Ocean, or Gulf of Mexico, affects average long term temperatures, humidity, and annual precipitation averages for different areas.
- The differences in elevation and landforms (i.e. mountains, deserts, and plains) affect the average long term temperatures and types of precipitation in different areas.

NOTE TO TEACHER: When collecting data students should record the same variables at each different location. For example: rainfall, temperature and wind speed from Minneapolis, Atlanta, and Miami.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may use weather maps and collect, analyze, and interpret data about barometric pressure, isobars, and isotherms.
- Students may collect, analyze, and interpret data from weather station models beyond what is specified in **4.E.2B.1**
- Students may construct explanations for how other geographic features (beyond those mentioned above) contribute to regional climate differences.
- Students may construct explanations for how global wind patterns contribute to regional climate differences.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Future Learning Connections (5-8):</p> <p>6.E.2B.3: Develop and use models to represent how solar energy and convection impact Earth’s weather patterns and climate conditions (including global winds, the jet stream, and ocean currents).</p> <p>6.E.2B.4: Construct explanations for how climate is determined in an area (including latitude, elevation, shape of the land, distance from water, global winds, and ocean currents).</p>
-----------------------------	--

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 Indicator	4.E.3A.1 <u>Develop and use models</u> 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.
Science and Engineering Practice	4.S.1A.2 <u>Develop, use, and refine models</u> to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Scale, Proportion, and Quantity Systems and System Models

Essential Learning Experiences:

It is essential that students obtain information about the objects in the solar system.

- The Sun
 - The star at the center of our solar system
 - A large ball of extremely hot gas that gives off light and heat.
 - An ordinary star that looks so bright only because it is closer to the Earth than other stars.
- The planets
 - Spherical bodies that orbit/revolve around the Sun in the solar system.
 - May be small and rocky like Earth (Mercury, Venus, and Mars) and are closest to the Sun.
 - May be large with a surface made of gas (Jupiter, Saturn, Neptune, and Uranus) unlike Earth. These are known as the gas giants.
 - May have a moon, no moons, or multiple moons.
- The Earth
 - A planet that orbits around the Sun.
 - Earth has an atmosphere.
 - Earth is unique in the solar system because it has liquid water and life.

- The Earth's Moon
 - Is a small rocky body that orbits/revolves around the Earth.
 - Is covered in rocks and dust with many craters and has no atmosphere.

Planets in order from the Sun	Surface Composition
Mercury	Rock
Venus	Rock
Earth	Rock
Mars	Rock
Jupiter	Gas
Saturn	Gas
Uranus	Gas
Neptune	Gas

It is essential that students use the information they have obtained about the planets in the solar system to develop and use models to exemplify the following:

- The sequence of the named planets from the Sun outward.
- The location of the planets as they orbit/revolve around the Sun.
- The basic composition of the planets either as solid/rocky or gas.

NOTE TO TEACHER: The performance indicator is interpreted as main surface composition.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain information about the dwarf planets in the solar system, such as Pluto or Ceres.
- Students may further investigate additional specific data about each planet, including distance from sun, time of revolution, or rotation, names of the planets with rings; the names or number of moons a planet has.
- Students may further compare the Earth with the Sun, the Moon, or other planet beyond the characteristics listed under essential learning experiences.
- Students may obtain additional information about the composition of other planets, for example, how the presence of methane gas in the atmospheres of Uranus and Neptune result in their distinctive green and blue appearances.

- Students may further collect information to describe the Sun, including the nuclear process that takes place so that the Sun can produce heat and light and the types of radiation that the Sun gives off.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

<p>Learning Connections</p>	<p>Future Learning Connections (5-8):</p> <p>8.E.4A.1: Obtain and communicate information to model the position of the Sun in the universe, the shapes and composition of galaxies, and the measurement unit needed to identify star and galaxy locations.</p> <p>8.E.4B.1: Obtain and communicate information to model and compare the characteristics and movements of objects in the solar system (including planets, moons, asteroids, comets, and meteors).</p> <p>8.E.4B.2: Construct explanations for how gravity affects the motion of objects in the solar system and tides on Earth.</p>
------------------------------------	--

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 Indicator	4.E.3A.2: <u>Obtain and communicate information</u> to describe how constellations (including Ursa Major, Ursa Minor, and Orion) appear to move from Earth’s perspective throughout the seasons.
Science and Engineering Practice	4.S.1A.8: <u>Obtain and evaluate informational</u> 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. <u>Communicate</u> observations and explanations using the conventions and expectations of oral and written language.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Cause and Effect

Essential Learning Experiences:

It is essential that students obtain the following information about constellations from variety of sources, including models, informational texts, videos, guest speakers, and observations:

- 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. Though it is visible throughout the year because it is in the same part of the sky as Polaris, it is particularly easy to spot 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. Ursa Minor is visible throughout the year.
 - 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.
- Some constellations are visible in the night sky year round. These constellations appear to revolve around the North Star (Polaris) and are called circumpolar constellations. Ursa Major and Ursa Minor are circumpolar constellations.

It is essential for students to use the information they obtain about constellations to describe how the position of stars and constellations in the night sky appear to move throughout the night as a result of the Earth’s rotation.

It is essential for students to use the information they obtain about constellations to describe how some constellations, such as Orion, only appear in the sky during certain seasons as a result of the Earth’s orbit around the Sun.

It is essential for students to use the information they obtain about constellations to describe how some constellations, such as Ursa Major and Ursa Minor, are visible in the night sky throughout the entire year because they appear in the sky over the North Pole.

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. These stars are also visible throughout the year as opposed to constellations and stars that are only visible during certain seasons.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may further investigate the names of the stars in the constellations unless they are needed to identify the constellation or its location in the sky.
- Students may further investigation information about nebulae or galaxies contained in the constellations.
- Students may further investigate other constellations beyond those listed above.

- Students may investigate the mythological stories behind the names of different constellations.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

<p>Learning Connections</p>	<p>Previous Learning Connections (K-3): 1.E.3A.1: Use, analyze, and interpret data from observations to describe and predict seasonal patterns of sunrise and sunset.</p> <p>Future Learning Connections (5-8): 8.E.4B.3: Develop and use models to explain how seasons, caused by the tilt of Earth’s axis as it orbits the Sun, affects the length of the day and the amount of heating on Earth’s surface.</p>
------------------------------------	---

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 Indicator	4.E.3A.3: <u>Construct scientific arguments</u> to support claims about the importance of astronomy in navigation and exploration (including the use of telescopes, astrolabes, compasses, and sextants).
Science and Engineering Practice	4.S.1A.7: <u>Construct scientific arguments</u> to support claims, explanations, or designs using evidence from observations, data, or informational texts.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Structure and Function

Essential Learning Experiences:

It is essential that students obtain information from a variety of sources, including informational texts, videos, pictures, guest speakers, and modeling and using the instruments, related how the following navigation and explorations instruments are used: telescopes, astrolabes, compasses, and sextants.

- Astronomers are scientists who study outer space, and have special telescopes to collect kinds of light. This enables them to look deeper into the universe.
- A telescope can gather more light than the eye, so it makes faint, faraway objects seem brighter and closer.
- An astrolabe is an ancient astronomical instrument for solving problems relating to time and the position of the Sun and stars in the sky.
 - 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 an instrument that shows direction.
 - The needle on the compass always points to magnetic north which is near geographic north.
 - A compass identifies the cardinal directions (or points) – north, south, east, and west.

- On a map, a diagram called a compass rose shows the direction north, south, east and west.
- 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 latitude.

It is essential that students use their information as evidence to support claims related to how astronomy was important in the use of these instruments for navigation and exploration.

- Telescopes allow humans to observe distant objects in space that would otherwise not be possible with the naked eye alone.
- Astrolabes are used to determine the position of different objects in the sky at different times and in different positions as a result of the Earth's rotation.
- Compasses are used to determine direction relative to the Earth's magnetic North Pole (which is close to the Earth's North Pole axis)
- Sextants are used to determine the position of certain objects in space, such as the Sun or Polaris, at specific times to determine latitude.

NOTE TO TEACHER: Magnetic north wanders so it is not at exactly 90°N.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain additional information about the design of reflecting and refracting telescopes.
- Students may obtain additional information about the specific forms of electromagnetic radiation that different types are designed to observe.
- Students may construct or use different instruments, such as telescopes, astrolabes, compasses, or sextants.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3): 1.E.3A.3: Obtain and communicate information to describe how technology has enabled the study of the Sun, the Moon, planets, and stars.</p> <p>Future Learning Connections (5-8): 8.P.3A.6: Obtain and communicate information about how various instruments are</p>
-----------------------------	--

used to extend human senses by transmitting and detecting waves (such as radio, television, cell phones, and wireless computer networks) to exemplify how technological advancements and designs meet human needs.

8.E.4B.5: Obtain and communicate information to describe how data from technologies (including telescopes, spectrometers, satellites, space probes) provide information about objects in the solar system and the universe.

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.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 Indicator	4.E.3B.1: <u>Analyze and interpret data</u> from observations to describe patterns in the (1) location, (2) movement, and (3) appearance of the Moon throughout the year.
Science and Engineering Practice	4.S.1A.4: <u>Analyze and interpret data</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Cause and Effect Scale, Proportion, and Quantity

Essential Learning Experiences:

It is essential that students collect observational data for the Moon's appearance over the course of the ~29.5 day lunar cycle.

It is essential that students use their observational data along with information from other sources, including modeling of the Moon's movements around the Earth, informational texts, videos, guest speakers, etc. to do the following:

- Describe and identify the patterns of the Moon's changing appearance (the phases of the Moon) throughout its 29.5 day lunar cycle.
- Describe how the Moon reflects light from the Sun, with half of the Moon's surface always being illuminated by sunlight.
- Construct explanations for how each of the Moon's phases depends on how much of the illuminated side of the Moon is visible from the Earth depending on the current location of the Moon in its orbit around the Earth. The main phases of the Moon's appearance are:
 - New moon – the entire half/side of the Moon facing Earth is dark.
 - First quarter moon – the Moon appears as a half circle with the right half of the side of the Moon facing Earth is lighted and the left half is dark (in shadow).
 - Full moon – the entire half/side of the Moon facing Earth is lighted; the Moon appears as a full circle.

- Third quarter moon also known as the last quarter moon - the Moon appears as a half circle with the left half of the side of the Moon facing Earth is lighted and the right half is dark (in shadow).

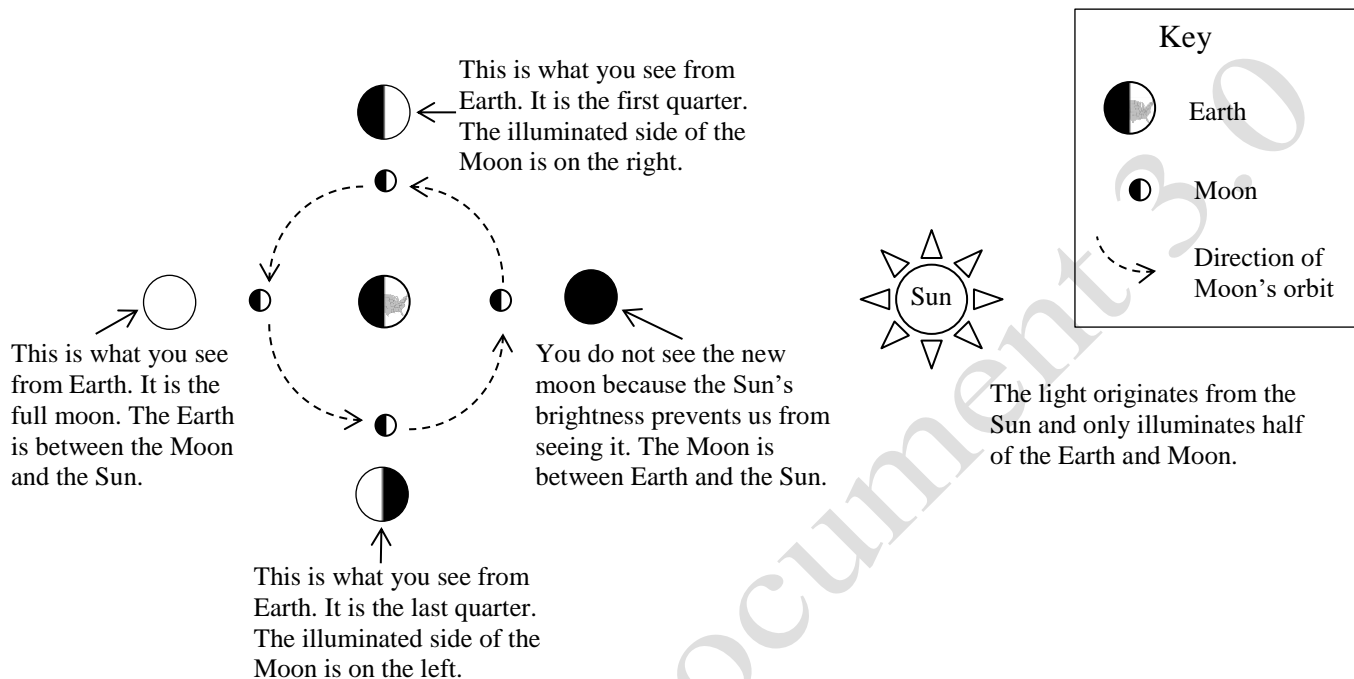


Figure 3. Moon phases (SCDE, 2018).

- Construct explanations for how the phases of the Moon gradually change as a result of the change in the Moon's location as it continually revolves around the Earth.

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.

The term illuminated refers to an object that is reflecting light from another source; in this case the Sun illuminates the Moon.

Each of the main phases is approximately one week apart: new moon and first quarter are about one week apart, first quarter and full moons are about one week apart, and so on.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain information to describe the transitional phases of the Moon’s appearance, including the crescent phases (when less than 50% of the Moon is visible) and gibbous phases (when more than 50% of the Moon is visible).
- Students may obtain information to describe how the gravitational relationship between the Earth and Moon cause the tides.
- Students may obtain information to describe how a lunar eclipse results from the Earth’s shadow blocking sunlight from illuminating the Moon.
- Students may obtain information to describe how a solar eclipse results from the Moon’s shadow blocking sunlight from striking a portion of the Earth’s surface.
- Students may obtain additional information to describe the Moon’s composition, the Moon’s orbit, or the Moon’s formation.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

[https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete 2014SEPsGuide_SupportDoc2_0.pdf](https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete%202014SEPsGuide_SupportDoc2_0.pdf)

Learning Connections	<p>Previous Learning Connections (K-3): 1.E.3A.2: Use data from personal observations to describe, predict, and develop models to exemplify how the appearance of the moon changes over time in a predictable pattern.</p> <p>Future Learning Connections (5-8): 8.E.4B.4: Develop and use models to explain how motions within the Sun-Earth-Moon system cause Earth phenomena (including day and year, moon phases, solar and lunar eclipses, and tides).</p>
-----------------------------	---

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.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 Indicator	4.E.3B.2: <u>Construct explanations</u> of how day and night result from Earth's rotation on its axis.
Science and Engineering Practice	4.S.1A.6: <u>Construct explanations</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect

Essential Learning Experiences:

It is essential that students use information from various sources, including observations, modeling, informational texts, simulations, videos, guest speakers, etc. to construct an explanation for the following phenomena:

- The Earth completes one full rotation on its axis over the course of 24 hours.
- Only half of the Earth's surface is illuminated by sunlight at any given time.
- The side of the Earth being illuminated by sunlight experiences day, and the side of the Earth not receiving sunlight experiences night.
- Earth's rotation causes any given location on the Earth's surface to move into and out of the sunlight, resulting in the transition from day to night.
- Earth rotates from west to east, resulting in the appearance of the Sun rising in the east and setting in the west.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may learn about and compare the rotation of other planets or the Moon with the Earth's rotational period.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>1.E.3A.1: Use, analyze, and interpret data from observations to describe and predict seasonal patterns of sunrise and sunset.</p> <p>1.E.3A.4: Conduct structured investigations to answer questions about the effect of sunlight on Earth’s surface.</p> <p>Future Learning Connections (5-8):</p> <p>8.E.4B.4: Develop and use models to explain how motions within the Sun-Earth-Moon system cause Earth phenomena (including day and year, moon phases, solar and lunar eclipses, and tides).</p>
-----------------------------	---

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.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 Indicator	4.E.3B.3: <u>Construct explanations</u> of how the Sun appears to move throughout the day using observations of shadows.
Science and Engineering Practice	4.S.1A.6: <u>Construct explanations</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Cause and Effect

Essential Learning Experiences:

It is essential that students collect observational and measurement data from the size and position of shadows on the Earth's surface relative to the position and height of the Sun in the sky at different times of the day.

It is essential that students use their observational and measurement data to construct explanations for the following phenomena they observe:

- 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.

It is essential that students use their observational and measurement data to construct explanations for how the apparent movement of the Sun across the sky is the result of the Earth's rotation on its axis.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain additional information about shadows, including the umbra and penumbra, and eclipses.
- Students may use their observations and measurements to construct sundials.

- Students may collect observations of shadows at different times of the year to compare the size and position of shadows as the position of the Sun in the sky appears to change relative to the changing of the seasons.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>1.P.2A.3: Conduct structured investigations to answer questions about how shadows change when the position of the light source changes.</p> <p>1.E.3A.1: Use, analyze, and interpret data from observations to describe and predict seasonal patterns of sunrise and sunset.</p> <p>1.E.3A.4: Conduct structured investigations to answer questions about the effect of sunlight on Earth’s surface.</p>
-----------------------------	---

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.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 Indicator	4.E.3B.4: <u>Develop and use models</u> to describe the factors (including tilt, revolution, and angle of sunlight) that result in Earth's seasonal changes.
Science and Engineering Practice	4.S.1A.2: <u>Develop, use, and refine models</u> to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect Scale, Proportion, and Quantity Systems and System Models

Essential Learning Experiences:

It is essential that students use information from various sources, including observations, measurements, modeling, informational sources, simulations, videos, guest speakers, etc. to develop models that illustrate the following phenomena:

- Earth is a sphere with a curved surface.
- Earth rotates around an imaginary straight line called an axis that runs through the planet's center from the North Pole to the South Pole
- Earth's axis is tilted at a 23.5° angle (it is not essential that students know this number, but it is essential that their model represent that the Earth's axis is tilted).
- Earth revolves around the Sun in an orbit that takes 1 year.
Earth's axis is always tilted in the same relative direction, regardless of where the Earth is in its orbit around the Sun.

It is essential that students use their models to illustrate how the following factors result in different seasons.

- The tilt of the axis causes the hemispheres to point toward or away from the Sun at different times during the Earth's revolution around the Sun.
- As Earth revolves around the Sun, the intensity of sunlight varies on different parts of the Earth depending on the tilt of the axis and the curved surface of the Earth.
- The parts of Earth receiving the most direct sunlight experience warmer temperatures.

- When a hemisphere is tilted toward the Sun, the season is summer because that part of the Earth is getting more direct sunlight.
 - The days are longer.
 - Temperatures are warmer.
 - The angle of the Sun hitting the Earth's surface is greater.
- When the hemisphere is tilted away from the Sun, the season is winter because that part of the Earth is getting less direct sunlight.
 - The days are shorter.
 - Temperatures are cooler.
 - The angle of the Sun hitting the Earth's surface is lower.
- When neither the northern or southern hemispheres are tilted towards the Sun, sunlight falls equally on both hemispheres resulting in autumn or spring.
 - Days and nights are about equal.
- The two hemispheres have opposite seasons.
- The seasons do not depend on the distance of Earth from the Sun.

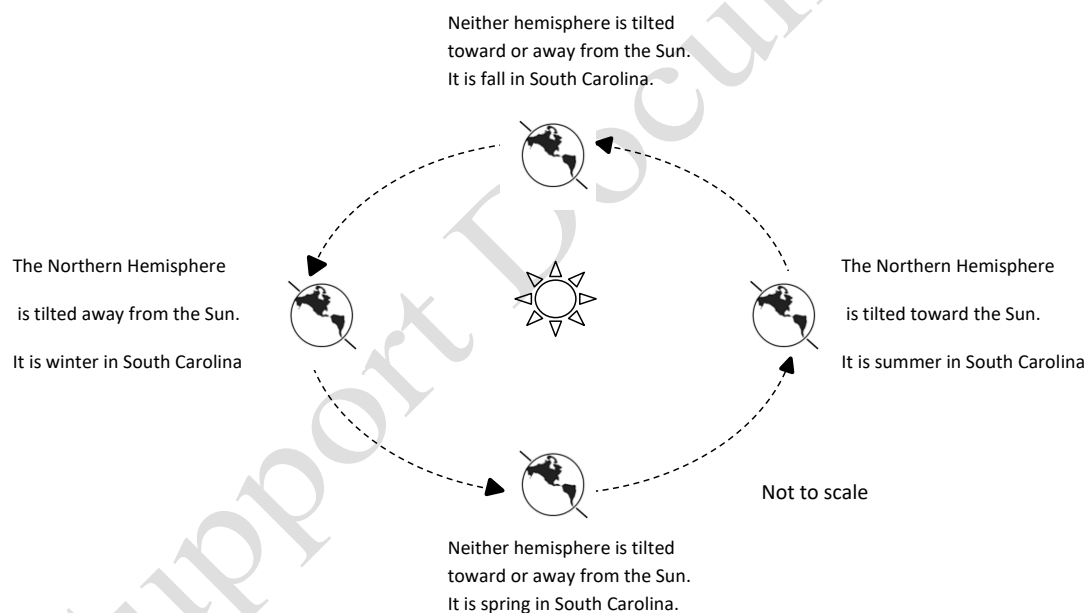


Figure 4. Seasons of hemispheres (SCDE, 2018).

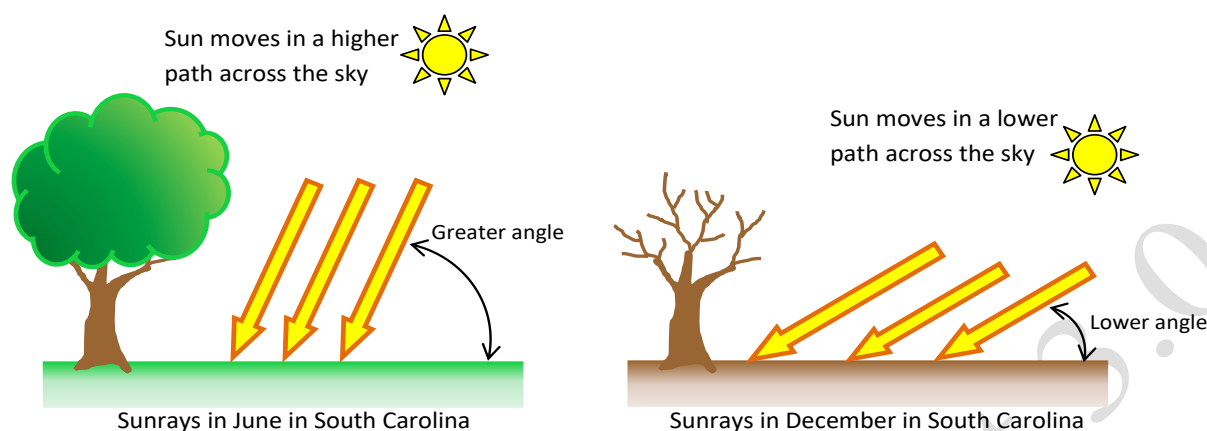


Figure 5. Sun in summer and winter (SCDE, 2018).

NOTE TO TEACHER:

Now may be an appropriate time to introduce the Tropic of Cancer (23.5° N) and the Tropic of Capricorn (23.5° S).

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may use their models to illustrate how the Earth's orbit around the Sun is elliptical and not truly circular.
- Students may use their models to illustrate the exact 23.5° angle of the Earth's tilt.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>K.E.3A.2: Develop and use models to predict seasonal weather patterns and changes.</p> <p>1.E.3A.1: Use, analyze, and interpret data from observations to describe and predict seasonal patterns of sunrise and sunset.</p> <p>Future Learning Connections (5-8):</p> <p>8.E.4B.3: Develop and use models to explain how seasons, caused by the tilt of Earth's axis as it orbits the Sun, affects the length of the day and the amount of heating on Earth's surface.</p>
-----------------------------	--

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 Indicator	4.P.4A.1: <u>Construct scientific arguments</u> to support the claim that white light is made up of different colors.
Science and Engineering Practice	4.S.1A.7: <u>Construct scientific arguments</u> to support claims, explanations, or designs using evidence from observations, data, or informational texts.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect

Essential Learning Experiences:

It is essential that students collect data from observations and investigations that illustrates how white light is split into different colors. Such investigations can include the following:

- Using a prism to refract white light causes the light to be split into the colors of the visible light spectrum.
- Using observation of rainbows forming when sunlight is refracted through droplets of water suspended in the air.
 - after a rain
 - the spray from a water hose
 - the mist from a waterfall

It is essential that students use the information and data collected from these investigations as evidence to support scientific claims that white light is made of different colors. Evidence and reasoning can include:

- Light shining in the prism is white but after shining through and being refracted by the prism, the colors of a rainbow can be seen (red, orange, yellow, green, blue, (indigo), violet).

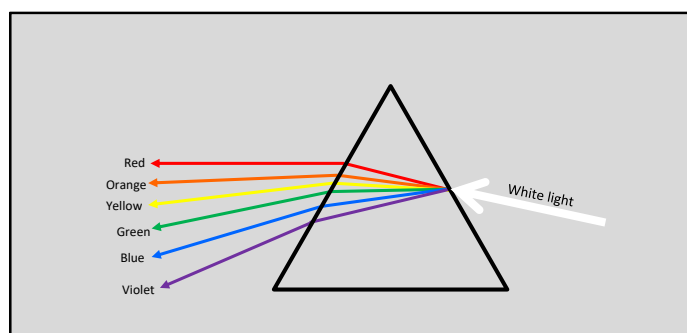


Figure 6. Light through prism (SCDE, 2018)

NOTE TO TEACHER: Students will use prisms and flashlights as part of their investigations to collect evidence to support claims about the nature of white light.

NOTE TO TEACHER: The color we see is the color of the visible light spectrum that is reflected. For example, a piece of red construction paper or a red apple shows that white light must include the color red for that color to be reflected back to the observer's eyes. The rest of the colors must be absorbed by the object since none are detected by the eye. Light in a classroom shines on many different colored objects, each one reflecting back a different color to the eyes of the observers (by absorbing the other colors of the white light and reflecting back only the color that is visible), even though the light shining in the classroom is white when it leaves the light source.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain information about how each different color results from different wavelengths and levels of energy.
- Students may obtain information about how astronomers use refracted light from distant stars to determine the chemical compositions of planets and stars.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

Fourth Grade Support Document – SCDE Office of Standards and Learning
June 2018

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

**Learning
Connections**

Future Learning Connections (5-8):

8.P.3A.3: Analyze and interpret data to describe the behavior of waves (including refraction, reflection, transmission, and absorption) as they interact with various materials.

8.P.3A.5: Construct explanations for how humans see color as a result of the transmission, absorption, and reflection of light waves by various materials.

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 Indicator	4.P.4A.2: <u>Analyze and interpret data</u> 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.
Science and Engineering Practice	4.S.1A.4: <u>Analyze and interpret data</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Cause and Effect

Essential Learning Experiences:

It is essential that students collect data through observations and measurements of the following:

- The apparent brightness of a light source as measured at different distance from the observer.
- The apparent brightness of different light sources relative to the intensity (absolute brightness) of the light source.

It is essential for students to use their data from their measurements and observations to describe the following phenomena:

- The closer an observer is to a light source, the brighter the light source appears.
- The further an observer is from a light source, the dimmer the light source appears.
- The more intense the light source, the brighter the light will appear to the observer.
- The less intense the light source, the dimmer the light will appear to the observer.
 - These claims can be supported both by descriptions of their observations as well as direct measurements using a simple light meter.

NOTE TO TEACHER: Students will use different light sources to investigate how brightness is affected by distance. Students may use flashlights, light bulbs, candle flames and meter sticks to measure distance between observers and light sources. This is a good opportunity for students to learn that the term luminous relates to an object (flame, lightbulb, Sun) producing its own light

and illuminated relates to an object (Moon, street signs, bicycle reflectors) reflecting light from another source.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may collect additional numerical data about brightness using a simple light meter (i.e.: a simple smartphone or computer app light meter)
- Students may collect data about the brightness of stars and objects in the night sky and compare the brightness with what they can learn about the different objects.
 - NOTE TO TEACHER: Students should NEVER look directly into the light from the sun or measure the brightness of sunlight without using some form of approved light filter, such as certified eclipse glasses.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3): 1.P.2A.1: Obtain and communicate information to describe how light is required to make objects visible.</p>
-----------------------------	--

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 Indicator	4.P.4A.3: <u>Obtain and communicate</u> information to explain how the visibility of an object is related to light.
Science and Engineering Practice	4.S.1A.8: <u>Obtain and evaluate</u> 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. <u>Communicate</u> observations and explanations using the conventions and expectations of oral and written language.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect

Essential Learning Experiences:

It is essential that students obtain information from a variety of sources, including investigations, observations, informational texts, videos, and pictures, that illustrates what happens to one's visibility in the presences and absence of light.

It is essential that students use the information they have obtained to construct the following explanations about light:

- Light is a form of energy that interacts with other objects.
- Light is necessary in order for something to be visible.
- Some objects, for example, the Sun, light bulbs, and flames are sources of light that radiate visible light energy (luminous). This is what allows them to be visible.
- Objects that reflect light, for example, the Moon, planets, books, chairs, and people are only visible because they reflect light from some other source (illuminated).

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain additional information to describe how light travels as a wave and how different wavelengths of light result in different colors.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections**Previous Learning Connections (K-3):**

1.P.2A.1: Obtain and communicate information to describe how light is required to make objects visible.

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 Indicator	4.P.4A.4: <u>Develop and use models</u> to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption) using evidence from observations.
Science and Engineering Practice	4.S.1A.2: <u>Develop, use, and refine models</u> to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Cause and Effect Systems and System Models Structure and Function

Essential Learning Experiences:

It is essential that students engage in investigations to collect observational data for how light behaves as it interacts with different materials in the following ways:

- What happens to light when it strikes a highly reflective surface, such as a mirror?
- What happens to light when it passes through materials that cause it to change direction?
- What happens to white light when it strikes materials that are different colors?

It is essential that students use their observational data to develop models that illustrate the following different ways that light interacts with materials:

- Reflection
 - Light is reflected when it strikes some object and bounces back in a different direction.
 - 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
 - Light is refracted when 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.
- Color
 - The colors of objects are determined by the light that is not absorbed but is reflected by the objects.
 - The color of the light that is reflected from an object is the color that the object appears.
 - All of the other colors of white light that are not visible are absorbed by the 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.

NOTE TO TEACHER: Students will use flashlights, mirrors, lenses, prisms, and transparent materials when investigating the way light interacts with different objects.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may investigate additional ways light is refracted by shining a laser pointer through cloudy water and seeing how the ray of light changes directions.
- Students may collect data on how absorption turns light energy into heat energy.
- Students may investigate how light interacts with different types of mirrors and lenses, including convex and concave mirrors and lenses.
- Students may investigate the interactions of different color pigments.
- Students may measure how the angle of light changes as it is reflected or refracted by different materials.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3): 1.P.2A.4: Develop and use models to describe what happens when light shines on mirrors based on observations and data collected.</p> <p>Future Learning Connections (5-8): 8.P.3A.3: Analyze and interpret data to describe the behavior of waves (including refraction, reflection, transmission, and absorption) as they interact with various materials. 8.P.3A.5: Construct explanations for how humans see color as a result of the transmission, absorption, and reflection of light waves by various materials.</p>
-----------------------------	---

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 Indicator	4.P.4A.5: <u>Plan and conduct scientific investigations</u> to explain how light behaves when it strikes transparent, translucent, and opaque materials.
Science and Engineering Practice	4.S.1A.3: <u>Plan and conduct scientific investigations</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Structure and Function

Essential Learning Experiences:

It is essential that students plan and carry out investigations to collect observational data for how light interacts with transparent, translucent, and opaque materials including the following steps:

- Generate scientifically testable questions about how light interacts with different materials.
- Plan the steps of an investigation to observe how light interacts with transparent, translucent, and opaque materials.
- Collect and organize observational data to describe the way light behaves as it interacts with these materials.

It is essential that students analyze and interpret observational data explain how different material is classified based on the different way light interacts with it, including the following:

- 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.

NOTE TO TEACHER: Students will use items that are transparent, translucent, and opaque, along with a light source to investigate how light interacts with materials, for example: glass beakers, plastic beaker, flashlight, prism, or any other appropriate materials.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may describe how light as a wave behaves as it interacts with different materials.
- Students may collect data using a simple light meter (i.e.: a simple smartphone or computer app light meter).

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

[https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete 2014SEPsGuide_SupportDoc2_0.pdf](https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete%202014SEPsGuide_SupportDoc2_0.pdf)

Learning Connections	<p>Previous Learning Connections (K-3): 1.P.2A.2: Analyze and interpret data from observations to compare how light behaves when it shines on different materials.</p> <p>Future Learning Connections (5-8): 8.P.3A.3: Analyze and interpret data to describe the behavior of waves (including refraction, reflection, transmission, and absorption) as they interact with various materials.</p>
-----------------------------	---

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.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 Indicator	4.P.4B.1: <u>Plan and conduct scientific investigations</u> to test how different variables affect the properties of sound (including pitch and volume).
Science and Engineering Practice	4.S.1A.3: <u>Plan and conduct scientific investigations</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Cause and Effect Structure and Function

Essential Learning Experiences:

It is essential that students plan and carry out investigations to collect data for how manipulating different variables can result in changing the volume and/or pitch of sounds being produced, including the following steps:

- Generate scientifically testable questions about how to change the volume and/or pitch of sounds.
- Plan the steps of an investigation to manipulate different variables, including those listed below, to see how these change the volume and pitch of sounds.
 - The thickness of the materials producing the sound (pitch)
 - The length of the materials producing the sound (pitch)
 - The tension of the materials producing the sound (pitch)
 - The amount of force used to produce the sound (volume)
 - The distance between the observer and the source of the sound (volume)
- Collect and organize data to describe the changes in the pitch and/or volume of sounds produced after manipulating different variables.

NOTE TO TEACHER: Students will use different items to produce sound vibrations, including tuning forks, musical instruments, glass beakers, as well as tools to measure the distance between the source of the sound vibrations and the listener.

NOTE TO TEACHER: The data collected through these investigations can be analyzed and interpreted to construct explanations for how changing these variables changes the vibrations that produced the sounds, resulting in differences in pitch and volume as part of performance indicator **4.P.4B.2**.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may investigate how sound behaves as a mechanical wave and how manipulating these variables changes the amplitude and frequency of the sound waves.
- Students may collect numerical data using different technologies for the pitch/frequency as well as the volume of the sounds.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Future Learning Connections (5-8): 8.P.3A.4: Analyze and interpret data to describe the behavior of mechanical waves as they intersect.</p>
-----------------------------	---

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.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 Indicator	4.P.4B.2: <u>Analyze and interpret data</u> from observations and measurements to describe how changes in vibration affects the pitch and volume of sound.
Science and Engineering Practice	4.S.1A.4: <u>Analyze and interpret data</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Cause and Effect Structure and Function

Essential Learning Experiences:

It is essential that students use, analyze, and interpret data collected from their investigations into sound (**4.P.4B.1**) in order to describe the following phenomena related to sound:

- Students use their data to describe how sound results from vibrations and how these vibrations can travel through different materials.
 - Sound is caused by vibrations (back and forth movements that occur very quickly)
 - Sound vibrations can be transferred from one material to another.
 - Sound vibrations can travel through solids, liquids, and gases.
 - Sound vibrations can travel through some materials better than others; for example, sound travels through liquids better than through air.
- Students use their data to describe how changing different variables related to vibrations changes the pitch of the sound.
 - Pitch is a measure of how high or low something sounds and is related to the speed of the vibrations that produce the sound.
 - Changing the thickness of the vibrating material can change the pitch. Thicker materials vibrate slower and produce a lower pitch. Thinner materials vibrate faster and produce a higher pitch.

- Changing the length of the vibrating material can change the pitch. Longer materials vibrate slower and produce a lower pitch. Shorter materials vibrate faster and produce a higher pitch.
- Changing the tension of the vibrating material can change the pitch. Increasing the tension of materials causes them to vibrate faster and produce a higher pitch. Decreasing the tension of materials causes them to vibrate slower and produce a lower pitch.
- Students use their data to describe how changing different variables related to vibrations changes the volume of the sound.
 - Volume is a measure of how loud or soft something sounds and is related to the strength of the vibrations.
 - Changing the amount of force that is exerted to produce the sound can change the volume. Exerting more force on materials to produce sounds will result in stronger vibrations and a louder volume. Exerting less force on materials to produce sounds will result in weaker vibrations and a softer volume.
 - Changing the distance between the source of the sounds and the listener can change the volume. The greater the distance between the source of the sound vibrations and the listener will result in a softer volume and quieter sound.

NOTE TO TEACHER: Students will use different items to produce sound vibrations, including tuning forks, musical instruments, glass beakers, as well as tools to measure the distance between the source of the sound vibrations and the listener.

NOTE TO TEACHER: The analyzed data used to construct explanations for how changing these variables changes the vibrations that produced the sounds, resulting in differences in pitch and volume should come from the investigations the students plan and carry out as part of performance indicator **4.P.4B.1**.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may investigate how sound behaves as a mechanical wave and how manipulating these variables changes the amplitude and frequency of the sound waves.
- Students may collect numerical data using different technologies for the pitch/frequency as well as the volume of the sounds.
- Students may investigate what happens to sound in a vacuum.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

[https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support% 20Documents/Complete 2014SEPsGuide SupportDoc2_0.pdf](https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete%202014SEPsGuide%20SupportDoc2_0.pdf)

**Learning
Connections****Future Learning Connections (5-8):**

8.P.3A.4: Analyze and interpret data to describe the behavior of mechanical waves as they intersect.

Support Document 3.0

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.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 Indicator	4.P.4B.3: <u>Define problems</u> related to the communication of information over a distance and <u>design devices or solutions</u> that use sound to solve the problem.
Science and Engineering Practice	4.S.1B.1: <u>Construct devices or design solutions</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Structure and Function

Essential Learning Experiences:

It is essential that students obtain information from different sources, for example observations, informational texts, and/or videos to identify and describe problems related to communicating information over different distances, including problems related to decreasing volume and clarity of sound as distance increases.

It is essential that students engage in the design process to design and test different solutions to solving the problem of communicating sound over different distances, including the following steps:

- Asking questions about the nature of the problems related to communicating information through sounds over different distances.
- Designing devices or devising solutions to these problems.
- Testing their devices or solutions in order to collect data related to the quality of sound over different distances.
- Analyzing and interpreting their data to determine if their solutions are successful based on the volume or clarity of the sound over different distances.
- Using their data to refine and retest their designs (if necessary).
- Communicating their solutions.

NOTE TO TEACHER: Students will use different items to produce sound vibrations, including tuning forks, musical instruments, glass beakers, as well as tools to measure the distance between the source of the sound vibrations and the listener.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may investigate how different materials affect the wave properties of sounds in a way that can be used to solve the problems related to communicating sound over different distances.
- Students may investigate the reasons why the volume and clarity of sound decrease over distance.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

[https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete 2014SEPsGuide_SupportDoc2_0.pdf](https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete%202014SEPsGuide_SupportDoc2_0.pdf)

Learning Connections	<p>Future Learning Connections (5-8): 8.P.3A.6: Obtain and communicate information about how various instruments are used to extend human senses by transmitting and detecting waves (such as radio, television, cell phones, and wireless computer networks) to exemplify how technological advancements and designs meet human needs.</p>
-----------------------------	--

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 Indicator	4.L.5A.1: <u>Obtain and communicate</u> information about the characteristics of plants and animals to develop models which classify plants as flowering or nonflowering and animals as vertebrate or invertebrate.
Science and Engineering Practice	4.S.1A.8: <u>Obtain and evaluate</u> 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. <u>Communicate</u> observations and explanations using the conventions and expectations of oral and written language.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Systems and System Models

Essential Learning Experiences:

It is essential that students obtain information from various sources, for example informational texts, videos, observations, expert speakers, and/or field studies about the characteristics of plants that allow them to be classified as flowering or non-flowering.

It is essential that students use their information to develop models that they can use to illustrate the basic characteristics of plants as well as how plants can be classified as flowering or non-flowering based on the following characteristics:

- Plants:
 - 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.
 - Grasses are also an example of a flowering plant.

- 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 are pines, spruce, or cedar trees that produce cones. Ferns and mosses produce spores.

It is essential that students obtain information from various sources, including informational texts, videos, observations, expert speakers, and /or field studies about the characteristics of animals that allow them to be classified as vertebrate or invertebrate.

It is essential that students use their information to develop models that they can use to illustrate how animals can be classified as vertebrate or invertebrate based on the following characteristics:

- Vertebrates
 - 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
 - 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 and worms.
 - Other examples of invertebrates are shrimp, crayfish, sponges, sea stars, or snails.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain additional information to further classify animals, both vertebrates and invertebrates beyond the levels described above.
- Student may obtain additional information to further classify plants based on other characteristics (vascular/nonvascular, monocot/dicot, etc.)
- Students may obtain additional information to describe the parts of different plants and animals.
- Students may obtain additional information to classify animals using scientific terminology (Kingdom, Phylum, Class, Order, Family, Genus, species)

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>K.L.2A.1: Obtain information to answer questions about different organisms found in the environment (such as plants, animals, or fungi).</p> <p>1.L.5A.1: Obtain and communicate information to construct explanations for how different plant structures (including roots, stems, leaves, flowers, fruits, and seeds) help plants survive, grow, and produce more plants.</p> <p>1.L.5A.2: Construct explanations of the stages of development of a flowering plant as it grows from a seed using observations and measurements.</p> <p>2.L.5A.1: Obtain and communicate information to classify animals (such as mammals, birds, amphibians, reptiles, fish, or insects) based on their physical characteristics.</p> <p>Future Learning Connections (5-8):</p> <p>6.L.4A.2: Develop and use models to classify organisms based on the current hierarchical taxonomic structure (including the kingdoms of protists, plants, fungi, and animals).</p> <p>6.L.4B.1: Analyze and interpret data related to the diversity of animals to support claims that all animals (vertebrates and invertebrates) share common characteristics.</p> <p>6.L.5B.1: Construct explanations of how the internal structures of vascular and nonvascular plants transport food and water.</p>
-----------------------------	--

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 Indicator	4.L.5A.2: <u>Analyze and interpret data</u> from observations and measurements to compare the stages of development of different seed plants.
Science and Engineering Practice	4.S.1A.4: <u>Analyze and interpret data</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Patterns Stability and Change

Essential Learning Experiences:

It is essential that students collect data from observations and measurements of different plants as they grow from seeds throughout their stages of development.

It is essential that students analyze and interpret their data to compare the following stages of development for different seed plants:

- 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 germinate (begin to grow).
- Seedling
 - Seedlings are the first sprouts from a seed.
 - Seedlings produce the parts of the plant that will be needed for adult plant survival.
 - 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,
 - They are able to reproduce using flowers or cones, which produce seeds.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may analyze and interpret data from observations to describe the specific parts of leaves or flowers.
- Students may analyze and interpret data to describe how photosynthesis occurs in the leaves of plants.
- Students may obtain information to describe how seed formation and development occurs in different plants.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3): 1.L.5A.2: Construct explanations of the stages of development of a flowering plant as it grows from a seed using observations and measurements.</p>
-----------------------------	--

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 Indicator	4.L.5A.3: <u>Develop and use models</u> to compare the stages of growth and development in various animals.
Science and Engineering Practice	4.S.1A.2: <u>Develop, use, and refine models</u> to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Systems and System Models Stability and Change

Essential Learning Experiences:

It is essential that students obtain information from various sources, including informational texts, observations, videos, pictures, and experts about the different stages of development for different groups of animals.

It is essential that students use this information to develop models that illustrate the following about the stages of growth and development for different animals:

- Some animals give birth to baby animals that look like small adults. As the babies grow, they change in size. Other changes might 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 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 Family	Stages of Development	Examples
Mammal	Young—Adult	Dog, squirrel, human, whale
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, mollies
	Egg – Young— Adult	Goldfish, catfish, bass

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

It is essential that students use their models to compare the stages of growth and development of different groups of animals.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain additional information to illustrate when different adaptations develop at different points in an animal's life cycle.
- Students may obtain additional information about the specific details of the metamorphosis of different animals, including incomplete metamorphosis.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

**Learning
Connections****Previous Learning Connections (K-3):**

2.L.5A.3: Construct explanations using observations and measurements of an animal as it grows and changes to describe the stages of development of the animal.

Support Document 3.0

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 Indicator	4.L.5A.4: <u>Construct scientific arguments</u> to support claims that some characteristics of organisms are inherited from parents and some are influenced by the environment.
Science and Engineering Practice	4.S.1A.7: <u>Construct scientific arguments</u> to support claims, explanations, or designs using evidence from observations, data, or informational texts.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect Structure and Function

Essential Learning Experiences:

It is essential that students obtain evidence from a variety of sources, including informational texts, observations, expert speakers, field studies, videos, and/or pictures about different characteristics that organisms exhibit.

It is essential that students use this information to determine whether some characteristic of an organism is inherited from its parents or influenced by its environment. For example:

- 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.

It is essential that students use evidence from their information (such as the examples described above) to support claims about the origin of these characteristics, either as inherited from its parents or influence by its environment.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain additional information about how inherited traits are a function of genetics as evidence to support claims.
- Students may obtain additional information about different tropisms or dormancy in plants as evidence to support claims.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>1.L.5B.2: Develop and use models to compare how the different characteristics of plants help them survive in distinct environments (including deserts, forests, and grasslands).</p> <p>2.L.5B.2: Develop and use models to exemplify characteristics of animals that help them survive in distinct environments (such as salt and freshwater, deserts, forests, wetlands, or polar lands).</p> <p>Future Learning Connections (5-8):</p> <p>6.L.4B.3: Construct explanations of how animal responses (including hibernation, migration, grouping, and courtship) to environmental stimuli allow them to survive and reproduce.</p> <p>6.L.4B.4: Obtain and communicate information to compare and classify innate and learned behaviors in animals.</p> <p>7.L.4A.1: Obtain and communicate information about the relationship between genes and chromosomes to construct explanations of their relationship to</p>
-----------------------------	--

inherited characteristics.

7.L.4A.2: Construct explanations for how genetic information is transferred from parent to offspring in organisms that reproduce sexually.

7.L.4A.6: Construct scientific arguments using evidence to support claims concerning the advantages and disadvantages of the use of technology (such as selective breeding, genetic engineering, or biomedical research) in influencing the transfer of genetic information.

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.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 Indicator	4.L.5B.1: <u>Develop and use models</u> to compare how humans and other animals use their senses and sensory organs to detect and respond to signals from the environment.
Science and Engineering Practice	4.S.1A.2: <u>Develop, use, and refine models</u> to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Structure and Function

Essential Learning Experiences:

It is essential that students obtain information from various sources, including informational texts, observations, expert speakers, field studies, videos, and/or pictures about different ways for how humans and animals use their sense and sensory organs to detect and respond to signals from the environment. For example:

- 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. Some animals have specialized senses. 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

It is essential that students use this information to develop models that they can use to illustrate and compare how different animals use their senses and sensory organs to obtain information about and respond to signals from the environment.

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 Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain additional information about sensory organs to illustrate the anatomy of human and animal sense organs.
- Students may obtain additional information to illustrate the function of the nervous system as it pertains to the senses.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>K.L.2A.3: Develop and use models to exemplify how animals use their body parts to (1) obtain food and other resources, (2) protect themselves, and (3) move from place to place.</p> <p>K.L.2A.4: Analyze and interpret data to describe how humans use their senses to learn about the world around them.</p> <p>2.L.5A.2: Construct explanations for how structures (including structures for seeing, hearing, grasping, protection, locomotion, and obtaining and using resources) of different animals help them survive.</p> <p>Future Learning Connections (5-8):</p> <p>6.L.4B.2: Obtain and communicate information to explain how the structural adaptations and processes of animals allow for defense, movement, or resource obtainment.</p> <p>6.L.4B.3: Construct explanations of how animal responses (including hibernation, migration, grouping, and courtship) to environmental stimuli allow them to survive and reproduce.</p>
-----------------------------	---

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.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 Indicator	4.L.5B.2: <u>Construct explanations</u> 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.
Science and Engineering Practice	4.S.1A.6: <u>Construct explanations</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect Structure and Function

Essential Learning Experiences:

It is essential that obtain information from various sources, including observations, informational texts, expert speakers, field studies, videos, and/or pictures use that information to describe the different structural adaptations that plants use to survive and reproduce, including:

- Roots
 - Roots take in water and nutrients from the habitat.
 - They may also hold the plant in place and store food and water.
- Stems
 - Stems move and store water and nutrients in the plant. Stems also provide support and protection for the plant.
- Leaves
 - Leaves produce food for plants in the presence of light.
- Flowers
 - Flowers often have special sizes, shapes, smells, or colors that attract organisms for pollination.
- Fruit
 - Fruits are formed around the seed to protect it.
 - Fruits can be consumed by different animals that help in dispersing seeds.
- Seeds
 - Seeds are how plants reproduce, with new plants growing from seeds that germinate.

○ Some seeds begin to grow as soon as conditions allow for germination
It is essential that students use this information to explain how each given structural adaptation is essential for the survival and reproduction of the plant in its native habitat. For example:

- Roots
 - 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
 - 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
 - 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 thin, waxy needles to protect them from freezing and from losing water.
- Flowers
 - 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
 - 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
 - Because most seeds may not survive, a plant produces many seeds, which need to be dispersed, or carried away.
 - Some examples of seed adaptations may be:
 - 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.
 - Some seeds are only dispersed when certain conditions are met, such as cones that only open to release their seeds following the intense heat of a forest fire.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain information to describe how the distinct structures within the different parts of plants, leaves, stems, seeds, flowers, etc. function to help the plant survive.
- Students may obtain information to describe how pollination and seed development occurs in plant reproduction.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>1.L.5A.1: Obtain and communicate information to construct explanations for how different plant structures (including roots, stems, leaves, flowers, fruits, and seeds) help plants survive, grow, and produce more plants.</p> <p>1.L.5B.2: Develop and use models to compare how the different characteristics of plants help them survive in distinct environments (including deserts, forests, and grasslands).</p> <p>Future Learning Connections (5-8):</p> <p>6.L.5B.1: Construct explanations of how the internal structures of vascular and nonvascular plants transport food and water.</p> <p>6.L.5B.2: Analyze and interpret data to explain how the processes of photosynthesis, respiration, and transpiration work together to meet the needs of plants.</p> <p>6.L.5B.3: Develop and use models to compare structural adaptations and processes that flowering plants use for defense, survival and reproduction.</p>
-----------------------------	--

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.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 Indicator	4.L.5B.3: <u>Construct explanations</u> for how structural adaptations (such as methods for defense, locomotion, obtaining resources, or camouflage) allow animals to survive in the environment.
Science and Engineering Practice	4.S.1A.6: <u>Construct explanations</u> 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.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect Structure and Function

Essential Learning Experiences:

It is essential that students obtain and use information from various sources, including observations, informational texts, expert speakers, field studies, videos, and pictures to describe the different structural adaptations that animals use to survive.

It is essential that students use this information to explain how each given structural adaptation is essential for the survival of the animal in its native habitat. For example:

- 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.

Extended Learning Experiences:

The following knowledge and learning experiences are not essential to the success of this learning goal but can be used by teachers to extend the depth and rigor of student engagements.

- Students may obtain information to construct explanations for how different behavior adaptations help animals survive.
- Students may obtain information about additional structural adaptations beyond those used for movement, defense, camouflage, and obtaining resources.

Assessment Guidelines:

Students should engage in multiple science and engineering practices when interacting with the content outlined in this performance indicator. For further information please see SEP Support Guide at:

https://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf

Learning Connections	<p>Previous Learning Connections (K-3):</p> <p>K.L.2A.3: Develop and use models to exemplify how animals use their body parts to (1) obtain food and other resources, (2) protect themselves, and (3) move from place to place.</p> <p>2.L.5A.2: Construct explanations for how structures (including structures for seeing, hearing, grasping, protection, locomotion, and obtaining and using resources) of different animals help them survive.</p>
-----------------------------	---

2.L.5B.2: Develop and use models to exemplify characteristics of animals that help them survive in distinct environments (such as salt and freshwater, deserts, forests, wetlands, or polar lands).

Future Learning Connections (5-8):

6.L.4B.2: Obtain and communicate information to explain how the structural adaptations and processes of animals allow for defense, movement, or resource obtainment.

6.L.4B.3: Construct explanations of how animal responses (including hibernation, migration, grouping, and courtship) to environmental stimuli allow them to survive and reproduce.

References

National Research Council. A Framework for k-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press, 2012. doi: 10.17226/13165.

South Carolina Department of Education. (2015). South Carolina Academic Standards and Performance Indicators for Science 2014. Retrieved from http://ed.sc.gov/scdoe/assets/file/agency/ccr/StandardsLearning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf