SUPPORT GUIDE 3.0
FOR FIFTH GRADE

SOUTH CAROLINA ACADEMIC STANDARDS AND PERFORMANCE INDICATORS FOR SCIENCE

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SOUTH CAROLINA
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INTRODUCTION TO GRADE FIVE 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 S*cience and Engineering Practice* standards, with indicators that are differentiated across grade levels and core areas. The term "practice" is used instead of the term "skill," to emphasize that scientists and engineers use skill and knowledge simultaneously, not in isolation. These eight science and engineering practices are:

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

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

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

For additional information regarding the development, use and assessment of the *2014 Academic Standards and Performance Indicators for Science* please see the official document that is posted on the SCDE science web page 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
1: First Grade
2: Second Grade
3: Third Grade
4: Fourth Grade
5: Fifth Grade
6: Sixth Grade
7: Seventh Grade
8: Eighth Grade
H.B: High school Biology I
H.B: High School Chemistry I
H.P: High school Physics I
H.E: High School Earth Science

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

S: Science and Engineering Practices
2: The number following the content area denotes the specific academic standard. In the example, the 2 in the indicator means that it is within the second academic standard with the Kindergarten science content.

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

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

CORE AREAS OF GRADE FIVE

- Physical Science: Matter and Mixtures
- Earth Science: Changes in Landforms and Oceans
- Life Science: Interdependent Relationships in Ecosystems
- Physical Science: Forces and Motion

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CONTENT SUPPORT GUIDE FOR GRADE FIVE 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.

Physical Science: Matter and Mixtures

Standard 5.P.2: The student will demonstrate an understanding of the physical properties of matter and mixtures.	
5.P.2A. Conceptual Understanding: Matter is made up of particles that are too small to be seen. Even though the particles are very small, the movement and spacing of these particles determines the basic properties of matter.	
Performance Indicator	**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.
Science and Engineering Practice	**5.S.1A.4:** Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support hypotheses, 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 Energy and Matter Systems and System Models

Essential Learning Experiences:
It is essential for students to collect data from measurements and observations of the physical properties of matter, including volume, shape, and the movement and spacing of particles.

It is essential for students to analyze and interpret their data in order to:

- Demonstrate that matter is anything that has mass and volume
- Explain that all matter is made up of very small particles too small to be seen
- It is the spacing and movement of these particles that give matter its basic properties.

It is essential for students to use their data to construct explanations for how matter can be classified as solid, liquid, or gas based on the following characteristics:

- Solids
    - Solids have a definite shape and volume.
    - Particles in a solid are very close to one another (dense) and vibrate, but stay in the same place.
    - The volume of a solid with rectangular sides can be determined by measuring with a ruler and calculating height x width x length.
    - The volume of an irregularly shaped solid can be determined by water displacement in a graduated cylinder. Water displacement in a graduated cylinder

can be found when the cylinder is filled with water and measured. The object is then placed in the cylinder and the water level is measured again. Subtract the water level of the graduated cylinder from the water level with the object and that is the volume of the irregularly shaped solid.
    - The volume of water displaced equals the volume of the object.
- Liquids
    - Liquids have a definite volume, but their shape changes according to the shape of their containers.
    - The particles are also close to one another, but they are able to move apart from each other and flow from place to place.
    - The volume of a liquid can be measured using a beaker, graduated cylinder or graduated syringe.
- Gases
    - Gases have no definite shape or volume, but take the shape and volume of their containers, filling the space available.
    - The particles easily move far apart from each other and spread out through the available space.

NOTE TO TEACHER: The following scientific tools may be used to make observations and measurements of the physical properties of matter: 10 x magnifier, metric ruler, tape measure, meter stick, graduated cylinder, beaker, graduated syringe, balance, mass weights.

Extended Learning Experiences:

- Name the particles of matter: atoms.
- Observe models of atoms.
- Identify that the volume of a gas changes when the pressure changes and identify how temperature changes can affect volumes of gases, liquids, and solids

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-4):** **K.P.4A.1:** Analyze and interpret data to compare the qualitative properties of objects (such as size, shape, color, texture, weight, flexibility, attraction to magnets, or ability to sink or float) and classify objects based on similar properties. **K.P.4A.2:** Develop and use models to describe and compare the properties of different materials (including wood, plastic, metal, cloth, and paper) and classify materials by their observable properties, by their uses, and by whether they are natural or human-made.

	2.P.3A.1: Analyze and interpret data from observations and measurements to describe the properties used to classify matter as a solid or a liquid. **3.P.2A.1:** Analyze and interpret data from observations and measurements to describe and compare the physical properties of matter (including length, mass, 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. **Future Learning Connections (6-8):** **7.P.2B.1:** Analyze and interpret data to describe substances using physical properties (including state, boiling/melting point, density, conductivity, color, hardness, and magnetic properties) and chemical properties (the ability to burn or rust). **7.P.2B.2:** Use mathematical and computational thinking to describe the relationship between the mass, volume, and density of a given substance.

Physical Science: Matter and Mixtures

Standard 5.P.2: The student will demonstrate an understanding of the physical properties of matter and mixtures.	
5.P.2B. Conceptual Understanding: A mixture is formed when two or more kinds of matter are put together. Sometimes when two or more different substances are mixed together, a new substance with different properties may be formed but the total amount (mass) of the substances is conserved. Solutions are a special type of mixture in which one substance is dissolved evenly into another substance. When the physical properties of the components in a mixture are not changed, they can be separated in different what happens to the properties of substances when two or more substances are mixed together physical ways.	
Performance Indicator	**5.P.2B.1:** Obtain and communicate information to describe what happens to the properties of substances when two or more substances are mixed together.
Science and Engineering Practice	**5.S.1A.8:** Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4) support hypotheses, explanations, claims, or designs. Communicate 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 Energy and Matter

Essential Learning Experiences:
It is essential for students to obtain information from various sources, including investigations, observations, measurements, informational texts, videos, pictures, etc. about what happens to the properties of substances when two or more substances are combined as a mixture.

It is essential for students to use their information to describe the following properties of substances and mixtures:

- Mixtures
  - Mixtures are composed of two or more substances that are mixed together, but can be separated from each other.
  - Mixtures can be made from various combinations of solids, liquids, or gases.
  - The substances in a mixture do not permanently change in the mixture, but they keep their separate properties (Physical change)
    - Examples of mixtures of solids, could include: trail mix, chef salad, a bucket of gravel and sand

        - Examples of mixtures of solids and liquids, could include: vegetable soup, cereal with milk
        - Examples of mixtures of liquids, could include oil and vinegar salad dressing
        - Examples of mixtures of liquids and gases, could include carbonated soft drinks (cola, root beer, orange soda)
- Solutions
    - They are composed of substances that mix so completely that they cannot be distinguished as separate substances, however, they can be separated back into separate substances
    - Examples of easy to make solutions could include: sun tea, flavored drink mix, salt water, sugar water, indigestion medicine tablet added to water

NOTE TO TEACHER: Students will analyze and interpret data to support claims that when two substances are mixed, the total amount (mass) of the substances does not change. It may be useful to collaboratively teach **5.P.2B.2**, and **5.P.2B.3** along with this standard. Students will develop models to describe mixtures, so you may find it useful to reuse mixtures created with this standard.

Extended Learning Experiences:

- Classify mixtures as heterogeneous or homogeneous
- recall that they can be distinguished from elements and compounds

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-4):** **2.P.3A.2:** Develop and use models to exemplify how matter can be mixed together and separated again based on the properties of the mixture. **Future Learning Connections (6-8):** **7.P.2A.3:** Analyze and interpret data to describe and classify matter as pure substances (elements or compounds) or mixtures (heterogeneous or homogeneous) based on composition. **7.P.2B.3:** Analyze and interpret data to compare the physical properties, chemical properties (neutralization to form a salt, reaction with metals), and pH of various solutions and classify solutions as acids or bases.

Physical Science: Matter and Mixtures

Standard 5.P.2: The student will demonstrate an understanding of the physical properties of matter and mixtures.	
5.P.2B. Conceptual Understanding: A mixture is formed when two or more kinds of matter are put together. Sometimes when two or more different substances are mixed together, a new substance with different properties may be formed but the total amount (mass) of the substances is conserved. Solutions are a special type of mixture in which one substance is dissolved evenly into another substance. When the physical properties of the components in a mixture are not changed, they can be separated in different physical ways.	
Performance Indicator	**5.P.2B.2:** Analyze and interpret data to support claims that when two substances are mixed the total amount (mass) of the substances does not change.
Science and Engineering Practice	**5.S.1A.4:** Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support hypotheses, 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. Energy and Matter Stability and Change

Essential Learning Experiences:
It is essential for students to collect data through investigations and measurements of the mass of substances both before and after they are combined into different mixtures.

It is essential for students to analyze and interpret data to demonstrate how the amount (mass) of matter does not change when two substances are mixed together.

- Matter can neither be created nor destroyed, but can be changed in form.
    - For example, when making pancakes, you combine ingredients (flour, baking soda, salt, sugar, milk, eggs, and butter) to create pancakes, but you do not create more ingredients, you just mix them together to form a new substance, pancakes.
- Because matter is neither created nor destroyed, the total mass of the materials before mixing materials together is the same as the total mass of materials after they are mixed together.
    - For example, dissolving sugar or salt into water: The separate masses of the sugar and the water measured before they are mixed and dissolved will be the same as the mass of the sugar-water after they are mixed.

- Sometimes, a solution results in a chemical change that may seem like some of the mass is lost. What really happens, however, is that some of the matter is converted into a gas that escapes and cannot be easily measured after the substances have been mixed.
    - For example, when an Alka-Seltzer® tablet is mixed with water the total mass will not equal the mass before mixing because some of the mass has been changed into a gas and escapes (the bubbles that form as the tablet is dissolving).
    - In the pancake example above, it is also likely that the post-mixing mass will not be the same because a chemical reaction occurs when the baking soda is added that results in some of the mass converting into a gas that escapes as bubbles.

NOTE TO TEACHER: Students will obtain and communicate information to describe what happens to the properties of substances when two or more substances are mixed together with **5.P.2B.1**, and will develop and use models to describe mixtures and solutions based on their properties with **5.P.2B.3**, so you may find it useful to teach these standards collaboratively in order to reuse mixtures.

NOTE TO TEACHER: The following scientific tools may be used to show evidence that when two substances are mixed the total amount (mass) of the substances does not change: balance, mass weights.

Extended Learning Experiences:

- Identify simple chemical symbols (H_2O water, NaCl table salt)
- Observe simple balanced chemical equations; recognize that an equation is balanced
- Law of Conservation of Matter
- Distinguish between physical and chemical changes

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	**Future Learning Connections (6-8):** **7.P.2B.5:** Develop and use models to explain how chemical reactions are supported by the law of conservation of matter.

Physical Science: Matter and Mixtures

Standard 5.P.2: The student will demonstrate an understanding of the physical properties of matter and mixtures.	
5.P.2B. Conceptual Understanding: A mixture is formed when two or more kinds of matter are put together. Sometimes when two or more different substances are mixed together, a new substance with different properties may be formed but the total amount (mass) of the substances is conserved. Solutions are a special type of mixture in which one substance is dissolved evenly into another substance. When the physical properties of the components in a mixture are not changed, they can be separated in different physical ways.	
Performance Indicator	**5.P.2B.3:** Develop models using observations to describe mixtures, including solutions, based on their characteristics.
Science and Engineering Practice	**5.S.1A.2:** Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
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 for students to obtain information from observations of the properties of mixture and solutions, including the following:

- Mixtures are composed of two or more substances that are mixed together but can be separated from each other.
- Solutions are types of mixtures composed of substances that mix so completely that they cannot be distinguished as separate substances.
- The mass of the original substances before being mixed together is the same as the mass of the mixture or solution of the combined substances.
- The properties of the different substances are still evident after they have been combined into a mixture or solution.

It is essential for students to develop models that can be used to describe the characteristics of mixtures and solutions.

- Examples of mixtures that can be demonstrated through their models could include: trail mix, fruit salad, chef salad
- Examples of solutions that can be demonstrated through their models could include: flavored drink mixes, salt water, sugar water, sweet tea

NOTE TO TEACHER: Students will obtain and communicate information to describe what happens to the properties of substances when two or more substances are mixed together with **5.P.2B.1**, and will analyze and interpret data to support claims that when two substances are mixed, the total amount (mass) of the substances does not change with **5.P.2B.2** so you may find it useful to teach these standards collaboratively in order to reuse mixtures.

Extended Learning Experiences:

- Identify that mixtures can be heterogeneous or homogeneous or that they can be distinguished from elements and compounds.

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-4):** **2.P.3A.2:** Develop and use models to exemplify how matter can be mixed together and separated again based on the properties of the mixture. **Future Learning Connections (6-8):** **7.P.2A.3:** Analyze and interpret data to describe and classify matter as pure substances (elements or compounds) or mixtures (heterogeneous or homogeneous) based on composition. **7.P.2B.3:** Analyze and interpret data to compare the physical properties, chemical properties (neutralization to form a salt, reaction with metals), and pH of various solutions and classify solutions as acids or bases.

Physical Science: Matter and Mixtures

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Performance Indicator	**5.P.2B.4:** Construct explanations for how the amount of solute and the solvent determine the concentration of a solution.
Science and Engineering Practice	**5.S.1A.6:** Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect Stability and Change

Essential Learning Experiences:

It is essential for students to construct explanations using data from investigations to describe the cause and effect relationship between the amounts of solute, solvent and resulting concentration of the solution including the following information:

- The substance in a solution that has the greatest amount is the *solvent*. It is usually the liquid.
- The substance in a solution that has the least amount is the *solute*. It is usually the solid.
- The relationship of the amount of solute to solvent determines the concentration of a solution.
    - The more solute a solution has compared to the amount of solvent, the more concentrated it is said to be.
    - When two solutions contain the same amount of solvent, the one with the greater amount of solute is the more concentrated solution
    - In order to make a solution more concentrated, more solute is added.
    - To make a solution less concentrated more solvent is added.

NOTE TO TEACHER: The following scientific tools may be used to measurement solute and solvents: measuring cups/spoons, beaker, graduated cylinder, graduated syringe.

Extended Learning Experiences:

- Identify specific quantitative relationships (ratios) of solutes and solvents in specific percent concentrations for solutions.

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	**Future Learning Connections (6-8):** **7.P.2B.3:** Analyze and interpret data to compare the physical properties, chemical properties (neutralization to form a salt, reaction with metals), and pH of various solutions and classify solutions as acids or bases.

Physical Science: Matter and Mixtures

Standard 5.P.2: The student will demonstrate an understanding of the physical properties of matter and mixtures.	
5.P.2B. Conceptual Understanding: A mixture is formed when two or more kinds of matter are put together. Sometimes when two or more different substances are mixed together, a new substance with different properties may be formed but the total amount (mass) of the substances is conserved. Solutions are a special type of mixture in which one substance is dissolved evenly into another substance. When the physical properties of the components in a mixture are not changed, they can be separated in different physical ways.	
Performance Indicator	**5. P.2B.5:** Conduct controlled scientific investigations to test how different variables (including temperature change, particle size, and stirring) affect the rate of dissolving.
Science and Engineering Practice	**5.S.1A.3:** Plan and conduct controlled scientific investigations to answer questions, test hypotheses and predictions, and develop explanations: (1) formulate scientific questions and testable hypotheses, (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. Cause and Effect Stability and Change

Essential Learning Experiences:

It is essential for students to conduct investigations to test how changing different variables affects the rate at which the solute dissolves in solvents, including the following steps:

- Following step-by-step instructions to test how different variables (temperature, stirring, and particle size) affect the rate at which a solute dissolves into a solvent when combining to form a solution.
- Collecting and organizing observational and measurement data about the rate at which the solute dissolves into the solvent under different conditions.
- Analyzing and interpreting data in order to answer testable questions about how different variables affect the rate of dissolving, including the following:
    - Temperature change
        - Usually, if the temperature increases, more of the solute will dissolve faster.

- Particle size
  - Usually, if the particle sizes are smaller, more of the solute will dissolve faster.
- Stirring
  - Usually, if the solution is stirred, more of the solute will dissolve faster.

NOTE TO TEACHER: The following scientific tools may be used to test the rate of dissolving: beaker, graduated cylinder, stopwatch.

Extended Learning Experiences:

- Investigate solubility of solutes
- Investigate and/or identify whether a solution is saturated or unsaturated

Assessment Guidelines:

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

Learning Connections	**Future Learning Connections (6-8):** **7.P.2B.4:** Plan and conduct controlled scientific investigations to answer questions about how physical and chemical changes affect the properties of different substances.

Physical Science: Matter and Mixtures

Standard 5.P.2: The student will demonstrate an understanding of the physical properties of matter and mixtures.	
5.P.2B. Conceptual Understanding: A mixture is formed when two or more kinds of matter are put together. Sometimes when two or more different substances are mixed together, a new substance with different properties may be formed but the total amount (mass) of the substances is conserved. Solutions are a special type of mixture in which one substance is dissolved evenly into another substance. When the physical properties of the components in a mixture are not changed, they can be separated in different physical ways.	
Performance Indicator	**5.P.2B.6:** Design and test the appropriate method(s) (such as filtration, sifting, attraction to magnets, evaporation, chromatography, or floatation) for separating various mixtures.
Science and Engineering Practice	**5.S.1B.1:** Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.
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 information from different sources, including observations, informational texts, and videos to identify and describe problems related to separating different types of mixtures and solutions.

It is essential that students engage in the design process to design and test different solutions to solving the problem of separating different types of mixtures, including the following steps:

- Asking questions about the nature of the problems related to separating different types of mixtures.
- Designing solutions to these problems.
- Testing their solutions in order to collect data related to the effectiveness of the following methods used to separate mixtures:
    - Filtration
        - Filtration is used to separate solid particles from a liquid.

        - For example, pouring the mixture through a filter paper in a funnel will trap the solid particles and only allow the particles of the liquid to pass through.
        - This method is used in water treatment plants as part of the process for separating dirt and other solid particles from water to produce clean drinking water.
    - Sifting
        - Sifting is used to separate smaller solid particles from larger solid particles.
        - For example, the mixture of different sized solid particles can be put into a container that has a screen material at the bottom with holes of a certain size.
        - When the mixture is shaken, the smaller particles go through the screen leaving the larger particles in the container.
        - Cooks, for example, sift flour to get a small particle size for baking leaving larger particles of flour in the sifter above the screen.
        - Sand and gravel companies, for example, separate rocks into different sized particles for road building and other construction projects using this method.
    - Magnetic Attraction
        - Magnetic attraction is used to separating magnetic material from a mixture of other substances.
        - When a magnet is stirred through the mixture, it pulls out the magnetic material from the mixture.
        - A cow magnet, for example, is given to a cow to swallow. It stays in the first stomach of the cow, keeping magnetic materials like wire and other harmful materials that cows swallow from going into the rest of their digestive system.
    - Evaporation
        - Evaporation is used to separate a solid that has dissolved in a liquid solution.
        - The solution is heated or left uncovered until all the liquid turns to a gas (evaporates) leaving the solid behind.
        - Salt in salt water or ocean water, for example, is separated by heating the solution until all the water evaporates leaving the solid salt in the container.
    - Chromatography
        - Chromatography is used to separate and analyze the solutes in a solution.
        - For example, a small amount (2-3 drops) of the solution is put on a piece of filter paper, which is put in a solvent.
        - The substances in the solution that dissolve most easily travel the furthest; and substances that do not dissolve easily do not travel very far.
        - The bands of color that are formed allow scientists to identify the substances in the solution by comparing them to the location of known substances forming bands of color on different filter papers.

    - Flotation
        - Floatation is used to separate solids that float from the remaining liquid in a mixture.
        - The solids are stirred and when they float to the top, they are skimmed off the surface of the liquid and put into a different container.
        - This method is used, for example, in some water purification plants.
- Analyzing and interpreting their data to determine if their solutions are successful based on the effectiveness of these different methods used to separate mixtures.
- Using their data to refine and retest their designs (if necessary).
- Communicating their solutions.

NOTE TO TEACHER: The following scientific tools may used to test appropriate methods for separating various mixtures: beaker, graduated cylinder, magnets, filter paper or coffee filters, funnel stand, funnels, screens, strainers, sifters, evaporation trays.

Extended Learning Experiences:

- Research mixtures that can be separated by more complicated methods than are discussed above.

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	**Future Learning Connections (6-8):** **7.P.2B.4:** Plan and conduct controlled scientific investigations to answer questions about how physical and chemical changes affect the properties of different substances.

Earth Science: Changes in Landforms and Oceans

Standard 5.E.3: The student will demonstrate an understanding of how natural processes and human activities affect the features of Earth's landforms and oceans.	
5.E.3A. Conceptual Understanding: Some of the land on Earth is located above water and some is located below the oceans. The downhill movement of water as it flows to the ocean shapes the appearance of the land. There are patterns in the location and structure of landforms found on the continents and those found on the ocean floor.	
Performance Indicator	**5.E.3A.1:** Construct explanations of how different landforms and surface features result from the location and movement of water on Earth's surface through watersheds (drainage basins) and rivers.
Science and Engineering Practice	**5.S.1A.6:** Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
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 for students to obtain information about the location and movement of water through watersheds and rivers from investigation, observations, videos, informational texts, pictures, guest experts, field studies including the following:

- The term watershed (drainage basin) can be described as all of the land that water flows over or through before reaching a lake or river.
    - Water is precipitation such as rain, snow, sleet, or hail.
    - A small amount of water from precipitation evaporates and moves back into the atmosphere immediately, and some water enters the ground. The rest is runoff.
    - The watershed acts as a "funnel" that collects and distributes water, and it is then channeled into a waterway.
    - Each basin is sectioned by what is called a water divide such as a ridge, hill, or mountain.
    - Each landform affects the path of the watershed.
    - Watersheds are large, or small; large basins are made up of many smaller basins.
    - Water from streams flows downward and meets with other water flows, gaining enough volume to become creeks and rivers. These moving bodies of water eventually flow to ponds, lakes, or the ocean.

It is essential that students use this information describe the cause and effect relationship between the movement of water and the resulting landforms and changes to the Earth's surface, including the following:

- The downhill movement of water as it flows to the ocean shapes the appearance of the land through the processes of weather, erosion, and deposition.
- The following surface features are examples of landforms created by the movement of water through watersheds and rivers:

Formation of Landforms	Landforms
V-shaped valleys are formed by the effects of running water	Valley
Canyons have steep walls and are formed by erosion and weathering of soft rock caused by the movement of water in rivers	Canyon
Deltas form from the deposition of the sediment carried by the river as the water flow leaves the mouth of the river. Deltas are shaped like a fan.	Delta

NOTE TO TEACHER: Students analyze and interpret data from observations and measurements to describe and predict the impact of weathering, erosion, and deposition on the Earth's surface with **5.E.3B.1** so you may find it useful to teach parts of these standards collaboratively.

NOTE TO TEACHER: The following scientific tools may be used to investigate the effects of moving water on landforms: stream tables.

Extended Learning Experiences:

- The different watershed paths have boundaries and specific names.
- Create a topographical map showing this information.
- There are also natural and human made pollutants that may contaminate watersheds. Pesticides, chemicals, sediments and organic matter may be examples of pollutants affecting basins.

Assessment Guidelines:

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Learning Connections	**Previous Learning Connections (K-4):** **1.E.4A.3:** Conduct structured investigations to answer questions about how the movement of water can change the shape of the land. **3.E.4B.2:** Plan and conduct scientific investigations to determine how natural processes (including weathering, erosion, and gravity) shape Earth's surface.

	Future Learning Connections (6-8): **8.E.5A.1:** Develop and use models to explain how the processes of weathering, erosion, and deposition change surface features in the environment.

Earth Science: Changes in Landforms and Oceans

Standard 5.E.3: The student will demonstrate an understanding of how natural processes and human activities affect the features of Earth's landforms and oceans.	
5.E.3A. Conceptual Understanding: Some of the land on Earth is located above water and some is located below the oceans. The downhill movement of water as it flows to the ocean shapes the appearance of the land. There are patterns in the location and structure of landforms found on the continents and those found on the ocean floor.	
Performance Indicator	**5.E.3A.2:** Develop and use models to describe and compare the characteristics and locations of the landforms on continents with those on the ocean floor (including the continental shelf and slope, the mid ocean ridge, the rift zone, the trench, and the abyssal plain.)
Science and Engineering Practice	**5.S.1A.2:** Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
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 for students to obtain information from various source, including informational texts, videos, pictures, investigation, models, guest experts, field studies, etc… about the characteristics and locations of continental landforms and ocean floor features, including the following:

- Earth's surface consists of land both above and covered by water. The land above the water contains landforms.
- The landforms on the continent include:
    - Volcanoes
        - An opening in Earth's surface from which lava flows.
        - As the lava hardens and builds up, a volcanic mountain forms.
    - Mountains
        - A place on Earth's surface where the land is much higher than the land that surrounds it.
        - Some mountains are tall and rocky and others are rounded and covered with trees.
        - A mountain area that has a flat top is called a plateau.
    - Valleys
        - A lowland area between higher areas such as mountains.

        - Sometimes rivers can wear away land to form valleys.
    - Canyons
        - A deep valley with very steep sides.
        - They are often carved from the Earth by a river.
    - Plains
        - A flat region of lowlands. Occurs at the bottoms of valleys.
- The land covered beneath the water (ocean floor) contains geologic structures, or landforms as well. There are similarities and differences between the landforms found on the continents and those found on the ocean floor.
- These features can be illustrated using detailed descriptions, pictures, or diagrams. These landforms include:
    - Continental shelf
        - The edges of the continents slope down from the shore into the ocean.
        - The part of the continent located under the water is known as the continental shelf.
        - The width of the continental shelf varies around the edges of the continents.
        - In some places the continental shelf is fairly shallow and in other place it becomes very deep, but it is not the deepest part of the ocean.
        - This is why the ocean typically becomes deeper as one moves farther from shore.
    - Continental slope
        - The steep slope where the continental shelf drops to the bottom of the ocean floor is called the continental slope.
        - The depth of the ocean water increases greatly here.
    - Mid-ocean ridge
        - On the bottom of the ocean, there is a central ridge, or mountain range, that divides the ocean floor into two parts.
        - These underwater volcanic mountains are known as the mid-ocean ridge.
        - Undersea volcanic mountains not formed on the mid-ocean ridge are called seamounts
        - If undersea volcanic mountains break the ocean's surface they are called volcanic islands.
    - Rift zone
        - In the center of the highest part of the mid-ocean ridge is a narrow trench called a rift.
        - Underwater volcanic activity that adds mountains to either side of the mid-ocean ridge occurs at the rift zone.
    - Trenches
        - There are many steep-sided canyons and deep, narrow valleys in the bottom of the ocean.
        - Ocean trenches are the deepest part of the ocean basin and are deeper than any valley found on land.
    - Abyssal plain
        - Begins where the continental slope flattens

- Flat or gently sloping, smooth area of the ocean floor
- Cover about 54% of the surface of the Earth

It is essential for students to use their information to develop models that they can use to describe and compare the characteristics and locations of the landforms on continents with those on the ocean floor.

Continental and Oceanic Landforms

Description	Continental Landform	Oceanic Landform
Low land between hills or mountains	Valley	Rift
Deep valley with high, steep sides	Canyon	Trench
An opening in the surface from which lava flows	Volcano	Seamount and Volcanic Islands
Land which rises high above the ground	Mountain Range	Mid-Ocean Ridge
Wide, flat areas of land	Plains	Abyssal Plains

Extended Learning Experiences:

- Know about ocean floor spreading, continental plates and boundaries.
- Deep-ocean exploration efforts.
- Deep ocean-mapping methods may give the students a better idea of how scientists learn about the features of the ocean floor.
- Know a comparison of other continental and oceanic features, or how they are made.

Assessment Guidelines:

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

Learning Connections	**Previous Learning Connections (K-4):** **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). **3.E.4A.2:** Develop and use models to describe and classify the pattern distribution of land and water features on Earth. **3.E.4B.1:** Develop and use models to describe the characteristics of Earth's continental landforms and classify landforms as volcanoes, mountains, valleys,

	canyons, plains, and islands. **Future Learning Connections (6-8):** **8.E.5A.5:** Construct and analyze scientific arguments to support claims that plate tectonics accounts for (1) the distribution of fossils on different continents, (2) the occurrence of earthquakes, and (3) continental and ocean floor features (including mountains, volcanoes, faults and trenches).

Earth Science: Changes in Landforms and Oceans

Standard 5.E.3: The student will demonstrate an understanding of how natural processes and human activities affect the features of Earth's landforms and oceans.	
5.E.3B. Conceptual Understanding: Earth's oceans and landforms can be affected by natural processes in various ways. Humans cannot eliminate natural hazards caused by these processes but can take steps to reduce their impacts. Human activities can affect the land and oceans in positive and negative ways.	
Performance Indicator	**5.E.3B.1:** Analyze and interpret data to describe and predict how natural processes (such as weathering, erosion, deposition, earthquakes, tsunamis, hurricanes, or storms) affect Earth's surface.
Science and Engineering Practice	**5.S.1A.4:** Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support hypotheses, 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 Stability and Change

Essential Learning Experiences:
It is essential for students to collect, analyze, and interpret data from investigations, observations, measurements, video clips, and informational sources about how the following natural processes affect the Earth's surface in both constructive and destructive ways:

- Constructive
  - Processes that create landforms (deposition, landslides, volcanic eruptions, floods)
- Destructive
  - Processes that destroy landforms (weathering, erosion, landslides, volcanic eruptions, earthquakes, floods)
- Natural processes that can affect Earth's oceans and land include:
  - Weathering
    - Weathering is a general term used to describe processes that break down rocks at or near the surface of the earth.
    - Any natural process that causes rocks to wear down or break apart is a cause of weathering.
    - Weathering can be either physical (mechanical breakdown of the rock) or chemical (a change in the chemical composition of the rock).

        - These processes cause the surface of the earth to dissolve, decompose, and break into smaller pieces. (physical & chemical)
        - Water is an important cause of weathering. (physical & chemical)
        - Plants cause weathering when roots break apart rock. (physical)
        - Changes in temperature can break rock, as well as ice forming inside cracks in the rock causing it to break even more. (physical)
        - Acid rain causes weathering. (chemical)
    - Erosion
        - Erosion is the movement of sediments and soil by wind, water (floods), ice (glaciers), and gravity.
    - Deposition
        - Deposition is the dropping, or depositing, of sediments by water, wind, or ice.
        - Deposition builds up new land on Earth's surface, like a delta at the end of a river or the accretion of a sand dune in the desert.
        - Shells on the beach are deposited by ocean waves.
    - Earthquakes
        - Earthquakes are vibrations on Earth's surface caused by sudden movement along a fault, or a break in Earth's surface.
        - Some earthquakes cause little damage and some cause a lot of damage.
        - Large earthquakes can cause landslides.
        - Earthquakes under the ocean can cause huge waves, called tsunamis that destroy land and cause great damage if they come ashore.
    - Tsunamis
        - Tsunamis are massive waves caused primarily caused by undersea earthquakes.
        - These waves can cause massive destruction along the coastlines of the body of water under which the earthquake occurs.
        - Tsunamis can cause significant coastal erosion, washing away sediments and material from a beach and depositing this materials far inland.
        - Not all undersea earthquakes cause Tsunamis.
        - Rarely, tsunamis can also be caused by large landslides of materials into an ocean or by asteroids or comets landing in an ocean.
    - Hurricanes and Storms
        - Storms and hurricanes can dump large amounts of rainwater that can trigger flooding that increases weathering and erosion.
        - Along coastal areas, storms and hurricanes can result in a large and dangerous storm surge wave that crashes into the coast when the storm first strikes land, washing away beach materials and human structures.

NOTE TO TEACHER: Although the following natural events can be described as either constructive or destructive in nature, they are not considered essential knowledge for **5.E.3B.1**, though they can be included in order to extend the learning experience:

- Landslides
- Volcanic eruptions
- Floods

NOTE TO TEACHER: The following scientific tools may be used to investigate the effects of weather, erosion, and deposition: stream tables.

Extended Learning Experiences:

- Know about ocean floor spreading, continental plates and boundaries.
- Deep-ocean exploration efforts
- Deep ocean-mapping methods may give the students a better idea of how scientists learn about the features of the ocean floor.
- Know a comparison of other continental and oceanic features, or how they are made.

Assessment Guidelines:

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Learning Connections	**Previous Learning Connections (K-4):** **1.E.4A.3:** Conduct structured investigations to answer questions about how the movement of water can change the shape of the land. **3.E.4B.2:** Plan and conduct scientific investigations to determine how natural processes (including weathering, erosion, and gravity) shape Earth's surface. **3.E.4B.3:** Obtain and communicate information to explain how natural events (such as fires, landslides, earthquakes, volcanic eruptions, or floods) and human activities (such as farming, mining, or building) impact the environment. **4.E.2B.2:** Obtain and communicate information about severe weather phenomena (including thunderstorms, hurricanes, and tornadoes) to explain steps humans can take to reduce the impact of severe weather phenomena. **Future Learning Connections (6-8):** **8.E.5A.1:** Develop and use models to explain how the processes of weathering, erosion, and deposition change surface features in the environment. **8.E.5A.5:** Construct and analyze scientific arguments to support claims that plate tectonics accounts for (1) the distribution of fossils on different continents, (2) the occurrence of earthquakes, and (3) continental and ocean floor features (including mountains, volcanoes, faults and trenches). **8.E.5B.1:** Analyze and interpret data to describe patterns in the location of

	volcanoes and earthquakes related to tectonic plate boundaries, interactions, and hot spots. **8.E.5B.2:** Construct explanations of how forces inside Earth result in earthquakes and volcanoes.

Earth Science: Changes in Landforms and Oceans

Standard 5.E.3: The student will demonstrate an understanding of how natural processes and human activities affect the features of Earth's landforms and oceans.	
5.E.3B. Conceptual Understanding: Earth's oceans and landforms can be affected by natural processes in various ways. Humans cannot eliminate natural hazards caused by these processes but can take steps to reduce their impacts. Human activities can affect the land and oceans in positive and negative ways.	
Performance Indicator	**5.E.3B.2:** Develop and use models to explain the effect of the movement of ocean water (including waves, currents, and tides) on the ocean shore zone (including beaches, barrier islands, estuaries, and inlets).
Science and Engineering Practice	**5.S.1A.2:** Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect Systems and System Models Stability and Change

Essential Learning Experiences:
It is essential for students to obtain information from investigations, observations, informational texts, videos, pictures, and guest experts to describe the cause and effect of impact of the movement of water on the ocean shore zone, including the following:

- The area where the ocean meets the land is called the ocean shore zone.
- The ocean shore zone has distinct geologic features that can be affected by waves, currents, tides, and storms.
- The movement of water along the shore zone can be classified as waves, currents, and tides.
    - Waves
        - Most waves are caused by winds moving across the surface of the ocean.
        - Waves can result in the weathering and erosion of beach sand and other beach materials.
        - Waves can also result in deposition of sand that builds up a beach.
        - Strong storms, such as hurricanes, can create very strong waves called storm surges that are extremely dangerous to coastal communities.

        - A tsunami, or tidal wave, is a giant wave that can be caused by undersea earthquakes, massive landslides that fall into an ocean, or the impact of asteroids or comets into an ocean.
    - Currents
        - Currents are continuously flowing streams of water. Longshore currents run parallel to the shoreline.
        - Currents can transport sediments (sand, soil, shells) from one part of a beach or slope to another.
    - Tides
        - Tides are caused by the relative position of the Moon around the Earth.
        - In most places, there are typically two high tides and two low tides during a 24 hour period.
        - During high tides, the water level along the shoreline moves up onto the beach.
        - During low tides, the water level along the shoreline retreats, exposing more beach.
        - High tides can deposit additional sediments to the beach.
        - Low tides can erode sediments from the beach.
    - Large storms, for example hurricanes, can also cause massive construction or destruction of beaches, barrier islands, estuaries, and inlets because they produce high waves, storm surges, and heavy winds.
- Beaches, barrier islands, estuaries, and inlets are all affected by these natural processes. Students should design and use models to describe how these natural processes impact the ocean shore zone.
    - Beaches
        - The shoreline, or coast, is the area where the land meets the ocean.
        - Some shorelines are rocky.
        - Shorelines made of sand are called beaches.
        - Shorelines are always changing because of wind and water.
        - Waves can wear away the land and expose a rocky shore.
        - Waves can also deposit sand along the shore and form a beach. If the waves reach the beach at an angle, the sand is moved along the coast.
        - Currents along the shoreline can move sand from one location to another.
        - Tides can bring in sand, shells, and ocean sediments at high tide and leave them behind when the tide goes out.
        - Storms can cause wave action that removes sand from beaches.
    - Barrier islands
        - Islands are pieces of land surrounded by water on all sides.
        - Islands with sandy beaches are called barrier islands.
        - These barrier islands are naturally occurring and function to protect the mainland from the effects of waves on its shore.
        - As the waves deposit and remove sand and soil on the beaches, the shapes of the barrier islands change.
        - Currents, flowing streams of continuous water, can move the sand from one end of the island to the other.

- Estuaries
  - The area where a river meets the ocean is known as an estuary, and all rivers flow into the oceans.
  - Estuaries have a mixture of freshwater and saltwater.
  - Waves can deposit sand in the estuaries.
  - At high tide, ocean water brings in sediments and sea life that feed and nourish life in the estuary.
- Inlets
  - Inlets are the water-filled spaces between the barrier islands.
  - As the tides change, the amount of water in the inlet will change.
  - Ocean currents and storms can change the shape of an inlet opening.

Extended Learning Experiences:

- Know about harbors or sounds as features.
- The effects of rip currents
- Longshore currents are the primary current studied.

Assessment Guidelines:

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Learning Connections	**Previous Learning Connections (K-4):** **1.E.4A.3:** Conduct structured investigations to answer questions about how the movement of water can change the shape of the land. **3.E.4B.2:** Plan and conduct scientific investigations to determine how natural processes (including weathering, erosion, and gravity) shape Earth's surface. **Future Learning Connections (6-8):** **8.E.5A.1:** Develop and use models to explain how the processes of weathering, erosion, and deposition change surface features in the environment.

Earth Science: Changes in Landforms and Oceans

Standard 5.E.3: The student will demonstrate an understanding of how natural processes and human activities affect the features of Earth's landforms and oceans.	
5.E.3B. Conceptual Understanding: Earth's oceans and landforms can be affected by natural processes in various ways. Humans cannot eliminate natural hazards caused by these processes but can take steps to reduce their impacts. Human activities can affect the land and oceans in positive and negative ways.	
Performance Indicator	**5.E.3B.3:** Construct scientific arguments to support claims that human activities (such as conservation efforts or pollution) affect the land and oceans of Earth.
Science and Engineering Practice	**5.S.1A.7:** Construct scientific arguments 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 Stability and Change

Essential Learning Experiences:
It is essential that students obtain information about how human activities such as conservation and pollution affect the land and oceans.

It is essential that students use their information as evidence to support claims for how different human activities affect the land and oceans in both positive and negative ways, including the following:

- Conservation Efforts
  - The wise use of natural resources is called conservation.
  - Natural resources are the materials that people can take or use from Earth.
  - Natural resources include air, water, trees, rocks and minerals, soil, coal and oil.
  - Human activities that help to keep the natural resources of Earth available and clear of pollution are conservation efforts.
  - Some efforts involve everyone trying to reduce (use less of something), reuse (use something over again), and recycle (make something new from an old product).
  - Other efforts involve trying to save the land and oceans through clean-up projects, installing fence lines to prevent dune erosion, jetties along the entrance to harbors or groins along beaches in an effort to keep sand from washing away.
  - Beach restoration projects help to restore sand on beaches.
  - Planting trees, bushes, or grass is a way to improve air quality as well as keep erosion from carrying away soil.

    - To conserve fossil fuels, humans may use cars that run on electricity, carpool, use public transportation, walk, ride a bike, etc. Buildings may use solar energy for electricity.
- Pollution
    - Pollution is anything that harms the natural environment.
    - When the taking or using of natural resources causes harm to Earth's air, water including oceans, or land, then the human activity has caused pollution.
    - Oceans are rich in food, minerals, and other resources and can be easily polluted.
    - Human activities can also harm the land and oceans causing resources to be polluted or destroyed.
    - Sometimes people may allow materials to be dumped into rivers not thinking that rivers flow into the estuaries and ocean where they are harmful to life there.
    - Careless dumping of trash on land or in oceans pollutes those areas; smoke and fumes from burning fuels pollutes the air; oil spills harm the ocean and can cause life there to be killed.
    - Careless human activities in agriculture, industry, construction, or mining can cause pollution on the land, in the water, and in the air.

Extended Learning Experiences:

- Identify areas of the land or ocean where resources are being conserved.

Assessment Guidelines:

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Learning Connections	**Previous Learning Connections (K-4):** **1.E.4B.1:** Obtain and communicate information to summarize how natural resources are used in different ways (such as soil and water to grow plants; rocks to make roads, walls, or buildings; or sand to make glass). **1.E.4B.2:** Obtain and communicate information to explain ways natural resources can be conserved (such as reducing trash through reuse, recycling, or replanting trees). **3.E.4A.3:** Obtain and communicate information to exemplify how humans obtain, use, and protect renewable and nonrenewable Earth resources. **3.E.4B.3:** Obtain and communicate information to explain how natural events (such as fires, landslides, earthquakes, volcanic eruptions, or floods) and human activities (such as farming, mining, or building) impact the environment. **Future Learning Connections (6-8):** **8.E.5C.1:** Obtain and communicate information regarding the physical and chemical properties of minerals, ores, and fossil fuels to describe their

	importance as Earth resources.

Earth Science: Changes in Landforms and Oceans

Standard 5.E.3: The student will demonstrate an understanding of how natural processes and human activities affect the features of Earth's landforms and oceans.	
5.E.3B. Conceptual Understanding: Earth's oceans and landforms can be affected by natural processes in various ways. Humans cannot eliminate natural hazards caused by these processes but can take steps to reduce their impacts. Human activities can affect the land and oceans in positive and negative ways.	
Performance Indicator	**5.E.3B.4:** Define problems caused by natural processes or human activities and test possible solutions to reduce the impact on landforms and the ocean shore zone.
Science and Engineering Practice	**5.S.1B.1:** Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect Stability and Change

Essential Learning Experiences:

It is essential that students obtain information from different sources, including observations, informational texts, and videos to identify and describe problems related to impact of natural processes and human activities on landforms and ocean shore zones.

It is essential that students engage in the design process to design and test different solutions to reducing the impact of natural processes and human activities on landforms and ocean shore zones, including the following steps:

- Asking questions about the nature of the problems caused by natural processes and human activities on landforms and ocean shoe zones.
- Designing solutions to these problems.
- Testing their solutions in order to collect data related to reducing the impact of natural processes and human activities on landforms and ocean shore zones, for example:
    - Problems caused by natural processes such as erosion and weathering can damage the earth's surface.
    - Erosion caused by wind and water can remove topsoil from fields causing an inability to grow crops or plants.

    - Human activities that have an impact of landforms and oceans include cutting down trees, building of dams on rivers, or dredging harbors to make deeper for larger boats, among others.
    - The building of groins on beaches also causes erosion.
    - Wakes from boating also cause erosion.
- Analyzing and interpreting their data to determine if their solutions are successful in reducing the impact of these events and processes.
- Using their data to refine and retest their designs (if necessary).
- Communicating their solutions.

Extended Learning Experiences:

- Know that different regions of the world may be affected in different ways due to climate, location, topography, and many other things.
- Compare and contrast the differences of processes between the different regions

Assessment Guidelines:

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Learning Connections	**Previous Learning Connections (K-4):** **3.E.4B.4:** Define problems caused by a natural event or human activity and design devices or solutions to reduce the impact on the environment. **Future Learning Connections (6-8):** **8.E.5B.3:** Define problems that may be caused by a catastrophic event resulting from plate movements and design possible devices or solutions to minimize the effects of that event on Earth's surface and/or human structures.

Life Science: Interdependent Relationships in Ecosystems

Standard 5.L.4: The student will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems.	
5.L.4A Conceptual Understanding: Ecosystems are complex, interactive systems that include both the living components (biotic factors) and physical components (abiotic factors) of the environment. Ecosystems can be classified as either terrestrial (such as forests, wetlands, and grasslands) or aquatic (such as oceans, estuaries, lakes, and ponds).	
Performance Indicator	**5.L.4A.1:** Analyze and interpret data to summarize the abiotic factors (including quantity of light and water, range of temperature, salinity, and soil composition) of different terrestrial ecosystems and aquatic ecosystems.
Science and Engineering Practice	**5.S.1A.4:** Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support hypotheses, 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 Scale, Proportion, and Quantity

Essential Learning Experiences:
It is essential for students to collect abiotic data from different sources for different terrestrial and aquatic ecosystems, including the following data:

- Quantity of light
- Quantity of water
- Temperature range
- Salinity
- Soil composition

It is essential that students analyze and interpret their data to summarize the abiotic factors of different terrestrial ecosystems and aquatic ecosystems, including the following:

- Ecosystems are made of both biotic and abiotic factors.
    - Bio is a Latin prefix meaning "life"
    - The living parts of the ecosystem are called biotic factors and include populations and communities of organisms.
    - The nonliving parts of the ecosystem are called abiotic factors and include temperature, water, soil, air, and sunlight. Abiotic means "lack of life"
- There are different types of ecosystems (terrestrial and aquatic). These ecosystems can be divided into two types according to their characteristics:

  - Terrestrial ecosystems are land-based ecosystems (including forests, wetlands, and grasslands).
  - Aquatic ecosystems are water-based ecosystems and may be fresh water (lakes and ponds) or saltwater (oceans, estuaries and saltwater marshes).
- Abiotic Factors of Terrestrial Ecosystems
  - Forests: have many trees (with needles or with leaves), shrub, grasses, and ferns, and a variety of animals.
    - Quantity of light: the forest canopy (top layer of the forest) receives many hours of sunlight. Therefore, the trees' leaves grow thickest near the top of the tree. The understory of the forest receives filtered sunlight; therefore, smaller shrubs and trees that require less sunlight to grow live in this layer.
    - Quantity of water: the amount of rainfall a forest receives varies depending on location. Forests receive more rainfall than grasslands.
    - Temperature range: may vary depending on where the forest is located. For example, average high and low temperature in a temperate forest ranges from about 0 degrees F to 70 degrees F
    - Salinity: with few exceptions, the water in a forest ecosystem is freshwater.
    - Soil composition: depends on type of forest. Example: In a temperate forest, decaying leaf matter contributes to fertile soil
  - Wetlands: an area of land that, at least part of the year, is under water. There are both freshwater and saltwater wetland ecosystems including marshes and swamps.
    - Quantity of light: marshes contain few trees, therefore, it receives a full day of sunlight. Swamps contain trees, allowing for filtered sunlight.
    - Quantity of water: the amount of water in this ecosystem depends on the amount of rainfall and depends on location.
    - Temperature range: in a wetland may vary depending on where the wetland is located.
    - Salinity: the salinity of the water of a wetland ecosystem depends on location. For example, the level of salinity in a salt marsh is affected by the tides and amount of rain the ecosystem receives
    - Soil composition: wetland soils are saturated (flooded) and oxygen poor, resulting in an organic-rich soil that is dark gray, green, or black in color.
  - Grasslands: there are various types of grasslands, including temperate grasslands (prairies, steppes) and savannas
    - Quantity of light: few trees grow in the grasslands; therefore, grasslands receive full sun all day long.
    - Quantity of water: rainfall will vary among various types of grasslands. Example, average rainfall for temperate grassland is between 50 - 88 cm (20 - 35 inches) yearly.
    - Temperature range: ranges will vary among various types of grasslands. Example, average day and night temperature for a temperate grassland ranges from well over 100 degrees F to below 0 degrees F
    - Salinity: the water in grasslands is typically freshwater.

        - Soil composition: grassland soils are usually fertile.
- Abiotic Factors of Aquatic Ecosystem
    - Oceans: are large bodies of saltwater divided by continents.
        - Quantity of light: the surface of the ocean receives full sunlight. However, deeper ocean water is colder and darker.
        - Quantity of water: amount of rainfall, input from rivers, and depth of ocean water varies from ocean to ocean.
        - Temperature range: surface and shallow temperatures will vary depending on latitude and location. Deep ocean water is colder than shallow ocean water due to the inability of sunlight to penetrate and warm the water at depth.
        - Salinity: ocean water is salty, though this can vary depending on the input of freshwater from rivers and melting sea ice.
        - Soil composition: the composition of the ocean floor will vary depending on the proximity to the shore zone, input from rivers, and the amount of organic material sinking to the ocean floor.
    - Estuaries: are found where the freshwater rivers meet the oceans.
        - Quantity of light: the amount of sunlight will vary depending on the location and the degree to which overhanging trees cast share over the edges of the estuary.
        - Quantity of water: the quantity of water will vary depending on the amount of rainfall and input from rivers.
        - Temperature range: temperatures will vary depending on latitude and location.
        - Salinity: estuaries are saltier than a river, but not as salty as the ocean. This is called brackish water. The amount of salt (salinity) changes as a result of the tides coming in and out as well as the amount of freshwater flowing in from the river.
        - Soil composition: the composition of the estuary floor will vary depending on sediment input from the river as well as the amount of sand and marine sediments carried in with waves and the tides.
    - Lakes and ponds: are bodies of freshwater that are surrounded by land.
        - Quantity of light: the amount of sunlight will vary depending on the location and the degree to which overhanging trees cast share over the edges of lakes or ponds.
        - Quantity of water: the quantity of water will vary depending on the amount of rainfall and input from rivers.
        - Temperature range: temperatures will vary depending on latitude and location. Ponds are shallow and will be primarily uniform in temperature. The temperature of deep lakes will decrease with depth.
        - Salinity: lakes and ponds are usually freshwater with some exceptions. Lakes and ponds near oceans may be brackish if waves and tides flow into the body of water. Lakes and ponds in arid (desert) areas may be salty as a result of mineral composition and frequent evaporation.

- Soil composition: the composition of the lake or pond floor will vary depending on sediment input from the rivers and streams.

NOTE TO TEACHER: The information listed above is general. Students should collect, analyze and interpret detailed abiotic data by researching specific ecosystems in particular locations.

Extended Learning Experiences:

- To further students' knowledge of ecosystems throughout our world, students might research ecosystems not listed in this indicator and identify specific examples of the abiotic factors in these ecosystems.

Assessment Guidelines:

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Learning Connections	**Previous Learning Connections (K-4):** **3.L.5A.1:** Analyze and interpret data about the characteristics of environments (including salt and fresh water, deserts, grasslands, forests, rain forests, and polar lands) to describe how the environment supports a variety of organisms. **Future Learning Connections (6-8):** **7.EC.5A.2:** Construct explanations of how soil quality (including composition, texture, particle size, permeability, and pH) affects the characteristics of an ecosystem using evidence from soil profiles.

Life Science: Interdependent Relationships in Ecosystems

Standard 5.L.4: The student will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems.	
5.L.4A Conceptual Understanding: Ecosystems are complex, interactive systems that include both the living components (biotic factors) and physical components (abiotic factors) of the environment. Ecosystems can be classified as either terrestrial (such as forests, wetlands, and grasslands) or aquatic (such as oceans, estuaries, lakes, and ponds).	
Performance Indicator	**5.L.4A.2:** Obtain and communicate information to describe and compare the biotic factors (including individual organisms, populations, and communities) of different terrestrial and aquatic ecosystems.
Science and Engineering Practice	**5.S.1A.8:** Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4) support hypotheses, explanations, claims, or designs. Communicate 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

Essential Learning Experiences:
It is essential for students to obtain and communicate information from various sources, including investigations, informational texts, videos, pictures, field studies, guest experts, etc… describe and compare the biotic factors in different aquatic and terrestrial ecosystems, including the following information:

- An ecosystem is a community of living organisms plus the nonliving components in their surrounding environment.
- The living parts of the ecosystem are called the biotic factors and include populations and communities of organisms. Organisms are defined as living plants and animals.
- The nonliving parts of the ecosystem are called the abiotic factors and include the temperature, water, soil, air, and sunlight. These help the biotic factors (organisms) to survive.
- The biotic organisms in an environment can be grouped in two ways:
    - Population
        - All members of one kind of organism that live in a particular area
        - Some examples of a population may be all of the white-tailed deer in a forest, all rainbow trout in a stream, or all of the bald cypress trees in a swamp.

- Communities
  - All of the different populations of organisms in an area that are coexisting at the same time
  - Some examples of communities are a city park community that consists of all of the squirrels, oak trees, and grass in that area. A desert community consists of all of the rattlesnakes, brush, cacti, and scorpions in that area.

NOTE TO TEACHER: The information listed above is general. Students should obtain specific biotic factors by researching specific ecosystems in particular locations.

NOTE TO TEACHER: Students need to be able to recognize, describe and compare the biotic factors (organisms, populations, and communities) in different ecosystems based on obtaining information from a variety of sources. It is NOT sufficient for students to simply be able to distinguish between living (biotic) and nonliving
(abiotic) things.

Extended Learning Experiences:

- Microorganisms are living things that are too small to be seen without magnification. Microorganisms can be a single-celled or multi-celled.
- A study of the types of microorganisms (paramecium, euglena, and amoeba) in an ecosystem would provide opportunity to extend students' knowledge of biotic factors in an ecosystem.

Assessment Guidelines:

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Learning Connections	**Previous Learning Connections (K-4):** **K.L.2A.6:** Obtain and communicate information about the needs of organisms to explain why they live in particular areas. **2.L.5B.1:** Obtain and communicate information to describe and compare how animals interact with other animals and plants in the environment. **3.L.5A.1:** Analyze and interpret data about the characteristics of environments (including salt and fresh water, deserts, grasslands, forests, rain forests, and polar lands) to describe how the environment supports a variety of organisms. **Future Learning Connections (6-8):** **7.EC.5A.1:** Develop and use models to describe the characteristics of the levels of organization within ecosystems (including species, populations, communities, ecosystems, and biomes).

Life Science: Interdependent Relationships in Ecosystems

Standard 5.L.4: The student will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems.	
5.L.4B Conceptual Understanding: All organisms need energy to live and grow. Energy is obtained from food. The role an organism serves in an ecosystem can be described by the way in which it gets its energy. Energy is transferred within an ecosystem as organisms produce, consume, or decompose food. A healthy ecosystem is one in which a diversity of life forms are able to meet their needs in a relatively stable web of life.	
Performance Indicator	**5.L.4B.1:** Analyze and interpret data to explain how organisms obtain their energy and classify organisms as producers, consumers (including herbivore, carnivore, and omnivore), or decomposers (such as fungi and bacteria).
Science and Engineering Practice	**5.S.1A.4:** Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support hypotheses, 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 Energy and Matter

Essential Learning Experiences:

It is essential for students to collect, analyze and interpret data from observations, investigations, videos, pictures, informational texts, field study, etc… to describe the cause and effect relationship between how different organisms obtain their energy and how it is classified, including the following:

- All organisms need energy to live, grow, and reproduce. This energy is obtained from food. The role an organism serves in an ecosystem can be described by the way in which it gets its energy.
- Producers
  - Plants are called producers because they are able to use light energy from the sun to produce food (sugar) from carbon dioxide in the air and water.
- Consumers
  - Consumers cannot make their own food so they must eat plants and/or other animals.
  - Animals are an example of consumers.
  - There are three main groups of consumers.
    - Herbivores eat only producers.

        - Carnivores eat only consumers.
        - Omnivores eat both producers and consumers.
- Decomposers
    - Decomposers (including microorganisms, termites, worms, and fungi) that get the energy they need by breaking down dead or decaying matter.
    - These decomposers speed up the decay process that releases nutrients back into the food chain for use by plants.

Extended Learning Experiences:

- To extend knowledge about relationships between organisms, students could study symbiotic relationships
- Ecosystems that are based on energy from chemosynthesis and not photosynthesis

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:
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Learning Connections	**Previous Learning Connections (K-4):** **3.L.5A.2:** Develop and use a food chain model to classify organisms as producers, consumers, and decomposers and to describe how organisms obtain energy. **Future Learning Connections (6-8):** **6.L.4A.1:** Obtain and communicate information to support claims that living organisms (1) obtain and use resources for energy, (2) respond to stimuli, (3) reproduce, and (4) grow and develop. **7.EC.5B.2:** Develop and use models (food webs and energy pyramids) to exemplify how the transfer of energy in an ecosystem supports the concept that energy is conserved.

Life Science: Interdependent Relationships in Ecosystems

Standard 5.L.4: The student will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems.	
5.L.4B Conceptual Understanding: All organisms need energy to live and grow. Energy is obtained from food. The role an organism serves in an ecosystem can be described by the way in which it gets its energy. Energy is transferred within an ecosystem as organisms produce, consume, or decompose food. A healthy ecosystem is one in which a diversity of life forms are able to meet their needs in a relatively stable web of life.	
Performance Indicator	**5.L.4B.2:** Develop and use models of food chains and food webs to describe the flow of energy in an ecosystem.
Science and Engineering Practice	**5.S.1A.2:** Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
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 Matter and Energy

Essential Learning Experiences:
It is essential for students obtain information from various sources, including observations, investigations, videos, pictures, field studies, informational texts, etc… about how organisms interact and obtain energy in an ecosystem.

It is essential for students to use their information to develop and use models of food chains and food webs to describe the flow of energy in an ecosystem, including the following information:

- Food chains and food webs can be used to show how energy is passed through an ecosystem.
    - A food chain is a linear sequence of plants and animals in which each organism is a source of food (energy) for the next in the sequence.
    - In a typical food chain, plants use the sun's energy to make their own food and then are eaten by one kind of animal, which in turn is eaten by another kind of animal.
    - Most organisms are part of more than one food chain and eat more than one kind of food in order to meet their energy requirements.
- Interconnected food chains form a food web.
    - Most food chains have no more than six organisms.
    - There cannot be too many links in a single food chain because the animals at the end of the chain will not get enough food (energy) to stay alive.
    - The role of an organism can be identified by its placement on the food chain.

- Decomposers are not typically noted on a food chain; they will break down any organism on the food chain when it dies.

- An example of a grassland food chain:

Sun →	**Grass →**	**Grasshopper →**	**Toad → Snake → Hawk**
	Producer	Consumer	Consumers

- An example of a grassland food web:

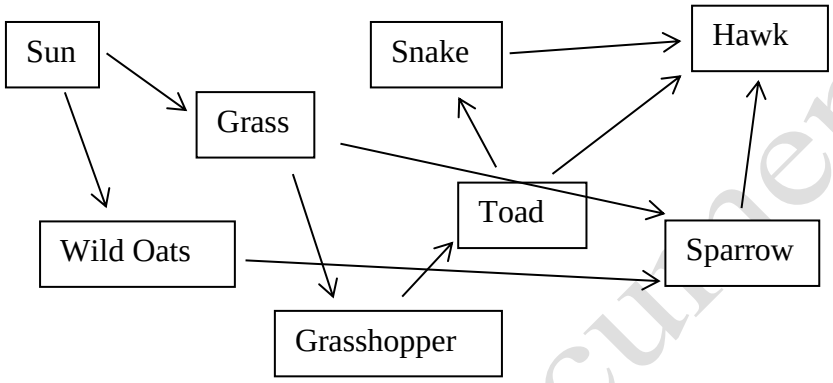

Figure 2. Food web (SCDE, 2018).

Extended Learning Experiences:

- To further students' knowledge of energy flow, students might identify trophic levels found in a food chain or web, or identify energy pyramids.

Assessment Guidelines:

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Learning Connections	**Previous Learning Connections (K-4):** **3.L.5A.2:** Develop and use a food chain model to classify organisms as producers, consumers, and decomposers and to describe how organisms obtain energy. **Future Learning Connections (6-8):** **7.EC.5B.2:** Develop and use models (food webs and energy pyramids) to exemplify how the transfer of energy in an ecosystem supports the concept that energy is conserved.

Life Science: Interdependent Relationships in Ecosystems

Standard 5.L.4: The student will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems.	
5.L.4B Conceptual Understanding: All organisms need energy to live and grow. Energy is obtained from food. The role an organism serves in an ecosystem can be described by the way in which it gets its energy. Energy is transferred within an ecosystem as organisms produce, consume, or decompose food. A healthy ecosystem is one in which a diversity of life forms are able to meet their needs in a relatively stable web of life.	
Performance Indicator	**5.L.4B.3:** Construct explanations for how organisms interact with each other in an ecosystem (including predators and prey, and parasites and hosts).
Science and Engineering Practice	**5.S.1A.6:** Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
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 for students to obtain information about how organisms interact with each other in an ecosystem in order to construct explanations for how organisms are classified based on how their relationships, including the following:

- Organisms can be identified based on how they interact with other organisms.
    - Predators are animals that hunt and kill other animals for food.
    - Prey are animals that are hunted and killed as food for other animals.
    - A parasite is an organism that spends a significant portion of its life in or on a living host organism usually causing harm to the host without immediately killing it.
    - Hosts are organisms or cells that serve as a home or a source of food for a parasite
        - Spanish moss is a parasitic plant that clings to its host, the live oak tree
        - Ticks and lice are parasitic organisms that cling to their host animals and cause some harm.

Extended Learning Experiences:

- To extend student knowledge, students may study other relationships between organisms (mutualism, commensalism, or symbiosis).

Assessment Guidelines:

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Learning Connections	**Previous Learning Connections (K-4):** **2.L.5B.1:** Obtain and communicate information to describe and compare how animals interact with other animals and plants in the environment. **3.L.5A.2:** Develop and use a food chain model to classify organisms as producers, consumers, and decomposers and to describe how organisms obtain energy. **Future Learning Connections (6-8):** **7.EC.5B.1:** Develop and use models to explain how organisms interact in a competitive or mutually beneficial relationship for food, shelter, or space (including competition, mutualism, commensalism, parasitism, and predator-prey relationships).

Life Science: Interdependent Relationships in Ecosystems

Standard 5.L.4: The student will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems.	
5.L.4B Conceptual Understanding: All organisms need energy to live and grow. Energy is obtained from food. The role an organism serves in an ecosystem can be described by the way in which it gets its energy. Energy is transferred within an ecosystem as organisms produce, consume, or decompose food. A healthy ecosystem is one in which a diversity of life forms are able to meet their needs in a relatively stable web of life.	
Performance Indicator	**5.L.4B.4:** Construct scientific arguments to explain how limiting factors (including food, water, space, and shelter) or a newly introduced organism can affect an ecosystem.
Science and Engineering Practice	**5.S.1A.7:** Construct scientific arguments 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 Stability and Change

Essential Learning Experiences:
It is essential that students obtain information about limiting factors, including food, water, space, and shelter and about invasive species.

It is essential that students use their information as evidence to support claims for how limiting factors (including food, water, space, and shelter) or a newly introduced organism can affect an ecosystem, for example:

- An ecosystem only has a certain amount of food, water, space, and shelter to support a certain number of organisms.
- The relationship between numbers of organisms and the resources available in an ecosystem is often described as the balance of nature.
- A condition or resource that keeps a population at a certain size is known as a limiting factor.
- If any of the limiting factors change, animal and plant populations may also change.
- Some changes may cause a population to increase; others may cause a population to decrease.
- Increases in population may result in overcrowding. Sometimes a population will grow too large for the environment to support.
- If resources, such as water and food, are insufficient for the size of the population.

    - For example, a population may increase if there are more plants than usual in an area. The populations of animals that eat that plant may increase.
- If the population of predators increases, the population of prey will decrease.
- If the population of prey increases, the population of predators will also increase because of the availability of food.
- Other changes in limiting factors may cause a population to decrease.
- Some examples may be:
    - If the water supply in an area decreases, the population that needs that water may decrease. Then the population of animals that eat that animal could decrease, too.
    - If trees are cut down or die because of disease or parasites, the population of the animals that use the trees for food or shelter will decrease.
    - If organisms no longer have enough space to survive, they will either have to move or they will die. This change in space may be due to human influence or natural hazards.
- When a new organism is introduced to an ecosystem, this can also have an impact on the balance of that ecosystem.
    - A newly introduced organism is typically referred to as an invasive species .
    - Newly introduced organisms can compete with other established organisms for the same food, water, and shelter.
    - Because newly introduced organisms may not have any natural predators in their new ecosystems, they may increase in numbers, shutting out other organisms that they compete with for resources.
    - These original organisms might be driven out of their native habitat or might go extinct as a result.
    - Newly introduced organisms can also harm existing organisms that have no natural defenses against the invasive species.

Extended Learning Experiences:

- Study carrying capacity or how a change in climate affects population sizes.
- Conduct investigations to determine how changes in environmental factors affect the growth and development 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	**Previous Learning Connections (K-4):** **K.L.2A.6:** Obtain and communicate information about the needs of organisms to explain why they live in particular areas. **1.L.5B.3:** Analyze and interpret data from observations to describe how changes in the environment cause plants to respond in different ways (such as

	turning leaves toward the Sun, leaves changing color, leaves wilting, or trees shedding leaves). **2.L.5B.1:** Obtain and communicate information to describe and compare how animals interact with other animals and plants in the environment. **2.L.5B.3:** Analyze and interpret data from observations to describe how animals respond to changes in their environment (such as changes in food availability, water, or air). **2.L.5B.4:** Construct scientific arguments to explain how animals can change their environments (such as the shape of the land or the flow of water). **3.L.5B.1:** Obtain and communicate information to explain how changes in habitats (such as those that occur naturally or those caused by organisms) can be beneficial or harmful to the organisms that live there. **3.L.5B.2:** Develop and use models to explain how changes in a habitat cause plants and animals to respond in different ways (such as hibernating, migrating, responding to light, death, or extinction). **Future Learning Connections (6-8):** **6.L.4B.5:** Analyze and interpret data to compare how endothermic and ectothermic animals respond to changes in environmental temperature. **6.L.5B.4:** Plan and conduct controlled scientific investigations to determine how changes in environmental factors (such as air, water, light, minerals, or space) affect the growth and development of a flowering plant. **7.EC.5A.3:** Analyze and interpret data to predict changes in the number of organisms within a population when certain changes occur to the physical environment (such as changes due to natural hazards or limiting factors). **7.EC.5B.3:** Analyze and interpret data to predict how changes in the number of organisms of one species affects the balance of an ecosystem. **7.EC.5B.4:** Define problems caused by the introduction of a new species in an environment and design devices or solutions to minimize the impact(s) to the balance of an ecosystem. **8.E.6B.2:** Obtain and communicate information to support claims that natural and human-made factors can contribute to the extinction of species.

Physical Science: Forces and Motion

Standard 5.P.5 The student will demonstrate an understanding of the factors that affect the motion of an object.	
5.P.5A Conceptual Understanding: The motion of an object can be described in terms of its position, direction, and speed. The rate and motion of an object is determined by multiple factors.	
Performance Indicator	**5.P.5A.1** Use mathematical and computational thinking to describe and predict the motion of an object (including position, direction, and speed).
Science and Engineering Practice	**5.S.1A.5** Use mathematical and computational thinking to (1) express quantitative observations using appropriate metric units, (2) collect and analyze data, or (3) understand patterns, trends and relationships between variables.
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 Stability and Change

Essential Learning Experiences:
It is essential for students to collect data through measurements and investigations about the motion of different objects.

It is essential for students to use mathematical and computational thinking to describe motion in terms of position, direction, and speed as follows:

- Position
  - The position of an object is its location relative to another object (the reference point) for example "above", "below", "beside", "behind", "ahead of" plus the distance from the other object.
  - The distance (length) from the reference point changes when the object moves.
- Direction
  - Direction of motion is the course or path that an object is moving and can be determined by reading a compass using the terms "north", "south", "east", or "west."
  - Direction can also be described using the terms "right", or "left," "forward," or "toward" relative to another object, or "up", or "down" relative to Earth.
- Speed
  - A measure of how fast an object is moving.

NOTE TO TEACHER: Students should be able to measure the distance specific objects move in a given time. They can compare the relative speeds of different moving objects determining which is moving faster or slower.

Extended Learning Experiences:

- Research velocity (both speed and direction), or the concept of acceleration (changing speed)
- Calculate speed
- Research tools used to measure speed

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-4):** **2.P.4A.1:** Analyze and interpret data from observations and measurements to compare the effects of different strengths and directions of pushing and pulling on the motion of an object. **Future Learning Connections (6-8):** **8.P.2A.6:** Use mathematical and computational thinking to generate graphs that represent the motion of an object's position and speed as a function of time. **8.P.2A.7:** Use mathematical and computational thinking to describe the relationship between the speed and velocity (including positive and negative expression of direction) of an object in determining average speed (v=d/t).

Physical Science: Forces and Motion

Standard 5.P.5 The student will demonstrate an understanding of the factors that affect the motion of an object.	
5.P.5A Conceptual Understanding: The motion of an object can be described in terms of its position, direction, and speed. The rate and motion of an object is determined by multiple factors.	
Performance Indicator	**5.P.5A.2** Develop and use models to explain how the amount or type of force (contact and non-contact) affects the motion of an object.
Science and Engineering Practice	**5.S.1A.2** Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
Crosscutting Concepts	The following Crosscutting Concepts may be applied to the content of this indicator. For more information see page 6. Cause and Effect Systems and System Models Scale, Proportion, and Quantity Stability and Change

Essential Learning Experiences:
It is essential that students obtain information from various sources, including investigations, observations, measurements, informational texts, videos, pictures, etc… about the amount and type of forces applied to different objects that result in changes in motion.

It is essential for students to use their information to develop models that they can use to describe the cause and effect relationship between the amount or type of force applied to an object and the way that force changes the motion of the object, including the following:

- A force is a push or pull that can make things move faster, slower, stop, or change direction. Different forces (including magnetism, gravity, and friction) can affect motion.
    - Magnetism
        - Is a non-contact force
        - A force that acts at a distance and cannot be seen.
        - Materials that create this force are said to be magnetic and are called magnets.
        - The needle of a compass moves because of Earth's magnetism.
        - When like poles (S-S or N-N) of magnets are near each other, the magnetic force causes the poles to repel, and the magnets push away from each other.

        - When opposite poles (N-S or S-N) of magnets are near each other, the magnetic force causes the poles to attract, and the magnets pull toward each other.
        - The closer the objects, the greater the magnetic force.
        - The magnetic force is greatest at the poles of magnets.
    - Gravity
        - Is a non-contact force
        - A pull that attracts objects to each other.
        - This attraction is not noticeable unless one of the objects is very large, for example a planet, a moon, or the Sun.
        - The force of gravity between Earth and anything on it is extremely noticeable because the mass of Earth is so large.
        - The pull of Earth's gravity makes any object fall to the ground.
        - As the Moon goes around Earth, its gravity pulls on Earth causing water in the oceans to move toward the Moon.
        - Earth's gravity also pulls on the Moon. This force of gravity keeps the Moon moving around Earth.
        - Similarly, the pull of the Sun's gravity keeps Earth moving around the Sun.
    - Friction
        - Is a contact force
        - Is a force that acts against motion and slows down moving objects.
        - Occurs whenever a moving object interacts with matter (solid, liquid or gas).
        - Is the force that opposes motion (slows things down) between two surfaces that are touching.
        - The effect of friction can be observed as an object slides across a surface and slows down.
        - The rougher the surfaces are, and the harder the surfaces press together, the more friction there will be.
        - Using lubricants can reduce friction; for example motor oil, wax, or grease reduces friction by making surfaces smoother.
        - Without friction, it would be very hard to slow or stop the motion of objects.

NOTE TO TEACHER: Students will conduct investigations to test the effects of balanced and unbalanced forces on the motion of objects for **5.P.5A.3** and will analyze and interpret data to describe how a change of force, mass, or friction affects the motion of an object for **5.P.5A.4**, so you may find it useful to use the results of these investigations to teach these standards collaboratively and as the information students use to develop their models.

Extended Learning Experiences:

- Identify the quantitative relationships involved in forces affecting the motion of objects.

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-4):** **2.P.3B.1:** Conduct structured investigations to answer questions about how the poles of magnets attract and repel each other. **2.P.4A.1:** Analyze and interpret data from observations and measurements to compare the effects of different strengths and directions of pushing and pulling on the motion of an object. **2.P.4A.2:** Develop and use models to exemplify the effects of pushing and pulling on an object. **2.P.4A.3:** Construct explanations of the relationship between the motion of an object and the pull of gravity using observations and data collected. **2.P.4A.4:** Conduct structured investigations to answer questions about the relationship between friction and the motion of objects. **3.P.3B.1:** Develop and use models to describe and compare the properties of magnets and electromagnets (including polarity, attraction, repulsion, and strength). **Future Learning Connections (6-8):** **8.P.2A.1:** Plan and conduct controlled scientific investigations to test how varying the amount of force or mass of an object affects the motion (speed and direction), shape, or orientation of an object. **8.P.2A.5:** Analyze and interpret data to describe and predict the effects of forces (including gravitational and friction) on the speed and direction of an object.

Physical Science: Forces and Motion

Standard 5.P.5: The student will demonstrate an understanding of the factors that affect the motion of an object.	
5.P.5A Conceptual Understanding: The motion of an object can be described in terms of its position, direction, and speed. The rate and motion of an object is determined by multiple factors.	
Performance Indicator	**5.P.5A.3** Plan and conduct controlled scientific investigations to test the effects of balanced and unbalanced forces on the rate and direction of motion of objects.
Science and Engineering Practice	**5.S.1A.3** Plan and conduct controlled scientific investigations to answer questions, test hypotheses and predictions, and develop explanations: (1) formulate scientific questions and testable hypotheses, (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. Cause and Effect Scale, Proportion, and Quantity Stability and Change

Essential Learning Experiences:

It is essential that students plan and carry out investigations to collect data for how balanced and unbalanced forces affect the rate and direction of the motion of objects, including the following steps:

- Generate scientifically testable questions about how balanced and unbalanced forces affect the motion of objects.
- Plan the steps of an investigation to observe and measure balanced and unbalanced forces affect the motion of objects.
- Collect and organize observational data to describe the way balanced and unbalanced forces affect the motion of objects. .

It is essential that students analyze and interpret their data explain how balanced and unbalanced forces affect the motion of objects, including the following:

- Rate of motion is the speed of the object or how fast or slow the object is moving.
- Balanced forces produce no change in the motion of an object.
    - Therefore, if an object is not moving, it will stay motionless.

    - However, if an object is moving, it will maintain its rate of motion (speed) and direction.
    - Balanced forces are equal in strength and opposite in direction.
- Unbalanced forces produce a change in the motion of an object.
    - Therefore, a motionless object will begin to move, while an object that is already moving will change its speed and/or direction.
    - Several forces can act on an object at the same time.
    - An unbalanced force is one that does not have another force of equal magnitude and opposite direction off-setting it.
- Unbalanced forces can change the rate or direction of motion of an object in different ways:
    - Object at rest
        - If an unbalanced force acts on an object at rest, the object will move in the direction of the force. A stronger force (push or pull) will make it move faster.
    - Object in motion
        - If an object is moving, an unbalanced force will change the motion of the object in different ways depending on how the force is applied. The unbalanced force may speed the object up, slow it down, or make it change directions.
        - If the force is applied in the same direction as the object is moving, the object will speed it up.
        - If the force is applied in the opposite direction as the object is moving, the object will slow it down or stop it.
        - If the force is applied to the side of the moving object, the object will turn.

NOTE TO TEACHER: Students will develop and use models to explain how the amount or type of force affects the motion of objects for **5.P.5A.2** and will analyze and interpret data to describe how a change of force, mass, or friction affects the motion of an object for **5.P.5A.4**, so you may find it useful to use these investigations to teach these standards collaboratively and as the source of data students use for their analysis and models.

Extended Learning Experiences:

- Research the difference between speed and velocity
- Research the concept of acceleration

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-4):** **2.P.4A.1:** Analyze and interpret data from observations and measurements to compare the effects of different strengths and directions of pushing and pulling on the motion of an object. **2.P.4A.2:** Develop and use models to exemplify the effects of pushing and pulling on an object. **2.P.4A.3:** Construct explanations of the relationship between the motion of an object and the pull of gravity using observations and data collected. **2.P.4A.4:** Conduct structured investigations to answer questions about the relationship between friction and the motion of objects. **Future Learning Connections (6-8):** **8.P.2A.1:** Plan and conduct controlled scientific investigations to test how varying the amount of force or mass of an object affects the motion (speed and direction), shape, or orientation of an object. **8.P.2A.2:** Develop and use models to compare and predict the resulting effect of balanced and unbalanced forces on an object's motion in terms of magnitude and direction. **8.P.2A.4:** Analyze and interpret data to support claims that for every force exerted on an object there is an equal force exerted in the opposite direction (Newton's Third Law of Motion). **8.P.2A.5:** Analyze and interpret data to describe and predict the effects of forces (including gravitational and friction) on the speed and direction of an object.

Physical Science: Forces and Motion

Standard 5.P.5: The student will demonstrate an understanding of the factors that affect the motion of an object.	
5.P.5A Conceptual Understanding: The motion of an object can be described in terms of its position, direction, and speed. The rate and motion of an object is determined by multiple factors.	
Performance Indicator	**5.P.5A.4** Analyze and interpret data to describe how a change of force, a change in mass, or friction affects the motion of an object.
Science and Engineering Practice	**5.S.1A.4** Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support hypotheses, 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. Cause and Effect Scale, Proportion, and Quantity Stability and Change

Essential Learning Experiences:
It is essential for students to engage in investigations to collect data about how a change in forces, change in mass, or change in friction affects the motion of an object.

It is essential for students to analyze and interpret data in order to describe how the motion of an object can be affected by a change in force, a change in mass, or change in friction, for example:

- Change in Force
  - If there are two objects with the same mass, and one is acted on by a greater force than the other, the one acted on by the greater force will have the greatest change in speed.
  - It will speed up the most or slow down the most in a given amount of time.
- Change in Mass
  - If there are two objects, one with a greater mass than the other, and the same amount of force is applied to each object, the object with the lesser mass will have the greater change in speed.
  - It will speed up or slow down more in a given amount of time.
  - It is more difficult to change the speed of the object with the greater mass than the object with the lesser mass.
- Change in Friction
  - The force that opposes motion between two surfaces that are touching.

- The effect of friction can be observed as an object slides across a surface and slows down.
- The rougher the surfaces are, and the harder the surfaces press together, the more friction there will be.
- Lubricants can reduce the effects of friction; for example motor oil, wax, or grease reduces friction by making surfaces smoother.
- Friction occurs in liquids and gases as well as between solids.
- Without friction, it would be very hard to slow or stop the motion of objects.

NOTE TO TEACHER: Students will develop and use models to explain how the amount or type of force affects the motion of objects for **5.P.5A.2** and will conduct investigations to test the effects of balanced and unbalanced forces on the motion of objects for **5.P.5A.3**, so you may find it useful to use these investigations to teach these standards collaboratively and as the source of data students use for their analysis and models.

Extended Learning Experiences:

- Identify that the change of speed of an object is called acceleration
- Describe the quantitative relationships among mass, acceleration, and force
- Illustrate the relationship between mass and inertia

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-4):** **2.P.4A.1:** Analyze and interpret data from observations and measurements to compare the effects of different strengths and directions of pushing and pulling on the motion of an object. **2.P.4A.2:** Develop and use models to exemplify the effects of pushing and pulling on an object. **2.P.4A.3:** Construct explanations of the relationship between the motion of an object and the pull of gravity using observations and data collected. **2.P.4A.4:** Conduct structured investigations to answer questions about the relationship between friction and the motion of objects. **Future Learning Connections (6-8):** **8.P.2A.1:** Plan and conduct controlled scientific investigations to test how varying the amount of force or mass of an object affects the motion (speed and direction), shape, or orientation of an object. **8.P.2A.3:** Construct explanations for the relationship between the mass of an object and the concept of inertia (Newton's First Law of Motion).

	8.P.2A.5: Analyze and interpret data to describe and predict the effects of forces (including gravitational and friction) on the speed and direction of an object.

Physical Science: Forces and Motions

Standard 5.P.5 The student will demonstrate an understanding of the factors that affect the motion of an object.	
5.P.5A Conceptual Understanding: The motion of an object can be described in terms of its position, direction, and speed. The rate and motion of an object is determined by multiple factors.	
Performance Indicator	**5.P.5A.5** Design and test possible devices or solutions that reduce the effects of friction on the motion of an object.
Science and Engineering Practice	**5.S.1B.1** Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.
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 Stability and Change

Essential Learning Experiences:
It is essential that students obtain information from different sources, including investigations, measurements, observations, informational texts, videos, etc… to identify and describe problems related to the effects of friction on the motion of an object.

It is essential that students use this information to design and test solutions to solve the problems related to the effects of friction on the motion of objects, including the following steps:

- Asking questions about the nature of the problems related to the effects of friction on the motion of objects.
- Designing solutions to these problems.
- Testing their solutions in order to collect data related to reducing the impact of friction on the motion of objects, for example:
    - Texture of the surface
        - Rough surfaces tend to create more friction.
        - Smooth surfaces tend to create less friction.
    - Weight
        - The weight of objects affects the friction between objects in liquids and gases.

        - The weight of an object and/or size of the surface affects the friction on a moving object under the following circumstances: air resistance (such as the size of a parachute) or the resistance of an object as it glides through water (such as a boat).
    - Lubrication
        - Lubrication, for example oil or grease, reduces the effects of friction.
        - Without lubrication, moving parts of machines would slow down or stop very quickly.
- Analyzing and interpreting their data to determine if their solutions are successful in reducing the effects of friction on the motion of objects.
- Using their data to refine and retest their designs (if necessary).
- Communicating their solutions.

NOTE TO TEACHER: Students will analyze and interpret data to describe how changing friction affects the motion of an object with **5.P.5A.4** and will develop and use models to explain how the amount or type of force (including friction) affects motion with **5.P.5A.2**, so you can use these experiences to help students define the problems related to the effects of friction and as data to help them propose solutions.

Extended Learning Experiences:

- Identify why these factors affect friction.

Assessment Guidelines:

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

Learning Connections	**Previous Learning Connections (K-4):** **2.P.4A.4:** Conduct structured investigations to answer questions about the relationship between friction and the motion of objects. **2.P.4A.5:** Define problems related to the effects of friction and design possible solutions to reduce the effects on the motion of an object. **Future Learning Connections (6-8):** **8.P.2A.5:** Analyze and interpret data to describe and predict the effects of forces (including gravitational and friction) on the speed and direction of an object.

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