SC-Alt Science Support Guide

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Introduction

Introduction

The South Carolina Alternate Assessment (SC-Alt): Science Assessment and Instructional Support Guide document was developed to provide guidance to teachers for including students with significant cognitive disabilities in challenging academic instruction. The South Carolina Science standards are prioritized for students participating in the alternate assessment. This prioritized content, designated within the "It is essential for students to know" section for each core concept, preserves the essence of the grade-level expectations while narrowing the depth and breadth of content that students with significant cognitive disabilities are exposed to during instruction and assessment. This support guide identifies prioritized content, by grade level, core concept, and standard.

For each standard, prioritized content is addressed in the "It is essential for students to know:" in a narrative form to give the big picture across the core concept. The prioritized content is then presented as a matrix to show the continuum of the concept across complexity levels. The matrix shows varying access points to the prioritized content. A student's progression through content contained in the matrix is intended to be fluid. It is not the intent, nor should it be the practice, for a student to be exposed to content in a straight vertical line through one of the columns. Every student, regardless of disability, comes to class with a different set of prior knowledge and experiences. For this reason a student may be able to access some content from the middle complexity level; but may be able to access other concepts at the more complex level. Teachers should evaluate a student's ability in relation to the content and select the entry point based on that evaluation. Students should not be locked into receiving exposure to all content at the same entry point.

Sample activities for selected standards are provided in "Application of Performance Indicators at the Middle Level—Instructional Activities." The intent of providing these activities is to assist teachers in linking their instruction to the prioritized content. The support guide includes activity adaptations for more or less complexity. These adaptations provide suggestions for making the content accessible to students with a varying range of abilities within the classroom. The activities and adaptations provided are intended to serve as a model of how students participating in the SC-Alt Science assessment may receive academic instruction in science. There are many ways in which skills and concepts can be incorporated based on student's individual learning styles and needs. The support guide also includes a sample investigation for each core concept. Within the investigations, there is an emphasis on writing. The intent of this emphasis is to demonstrate a variety of ways in which writing can be incorporated across the curriculum for students with significant cognitive disabilities. The activities and investigations have been provided as examples with the intent that teachers will differentiate the activities and investigations for the diverse learning needs within a class. It is important to understand that students are not expected to rote recall the specific information included in sample activities.

As this guide is used, it is important to remember that students participating in SC-Alt are assigned to test forms based on their age, not grade level. The age corresponds to the grade level in which a student that age is typically enrolled. Age and typical grade level correspondence have been listed on the cover sheets. Information about age and grade level also can be found on the *Age and Birthdate Reference Sheet* for the current school year.

Incorporating Student Writing into the SC-Alt Science Content

Writing for students who participate in the alternate assessment may be demonstrated through many formats. Regardless of which format is selected, the opportunity to write as part of the science lesson reinforces the link between spoken and written communication. Writing activities have been incorporated throughout the *South Carolina Alternate Assessment (SC-Alt): Science Assessment and Instructional Support Guide* to show ways in which teachers may incorporate writing into science content lessons. The subject of science lends itself well to incorporating the opportunity for students to write. Having students keep a Science Journal as they progress through activities and investigations aligned to the prioritized science content is a seamless way to make this connection. Many activities and investigations include suggested writing activities or sample journal entries. Each student's Science Journal may look different based on his unique skill set in both science and writing. How a student writes within the journal can take many forms but may include completing a sentence using an object, picture symbol, words printed on a card, or writing his response in the blank (which may require a guide from which to copy). Students may also select from sentence strips (with or without picture symbols) to order events in an activity or investigation. Students can make selections for their Science Journal through vocalization, pointing, or eye gaze; or by use of an AAC device or switch.

Making Activities Accessible for Students with Sensory Impairments

When possible, the activities and investigations within the *South Carolina Alternate Assessment (SC-Alt): Science Assessment and Instructional Support Guide* have tried to address ways to adapt activities and investigations for students who may have hearing, vision, or other sensory needs. The intention of this support document is to provide a starting point for teachers as they plan classroom lessons. Activities and investigations should be adapted to meet the needs of all students within the classroom. Throughout this guide, teachers should substitute real objects, sounds, or textures as appropriate to make the content accessible and meaningful to students.

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Age 5 on or before September 1 (Kindergarten)

Kindergarten

Core Concept: Life Science: Exploring Organisms and the Environment

It is essential for students to know: Organisms are living things that need food, water, air, living space, and shelter to survive. Organisms can make a new living thing, like itself (K.L.2A.1, K.L.2A.5). In addition, plants need light to survive (K.L.2A.2). Animals use body parts to meet their needs for obtaining food and water as well as protection and movement (K.L.2A.3). Animals have five senses. Each sense is associated with a specific body part (K.L.2A.4). Organisms live in areas where their needs for air, food, shelter, and water are met (K.L.2A.6).

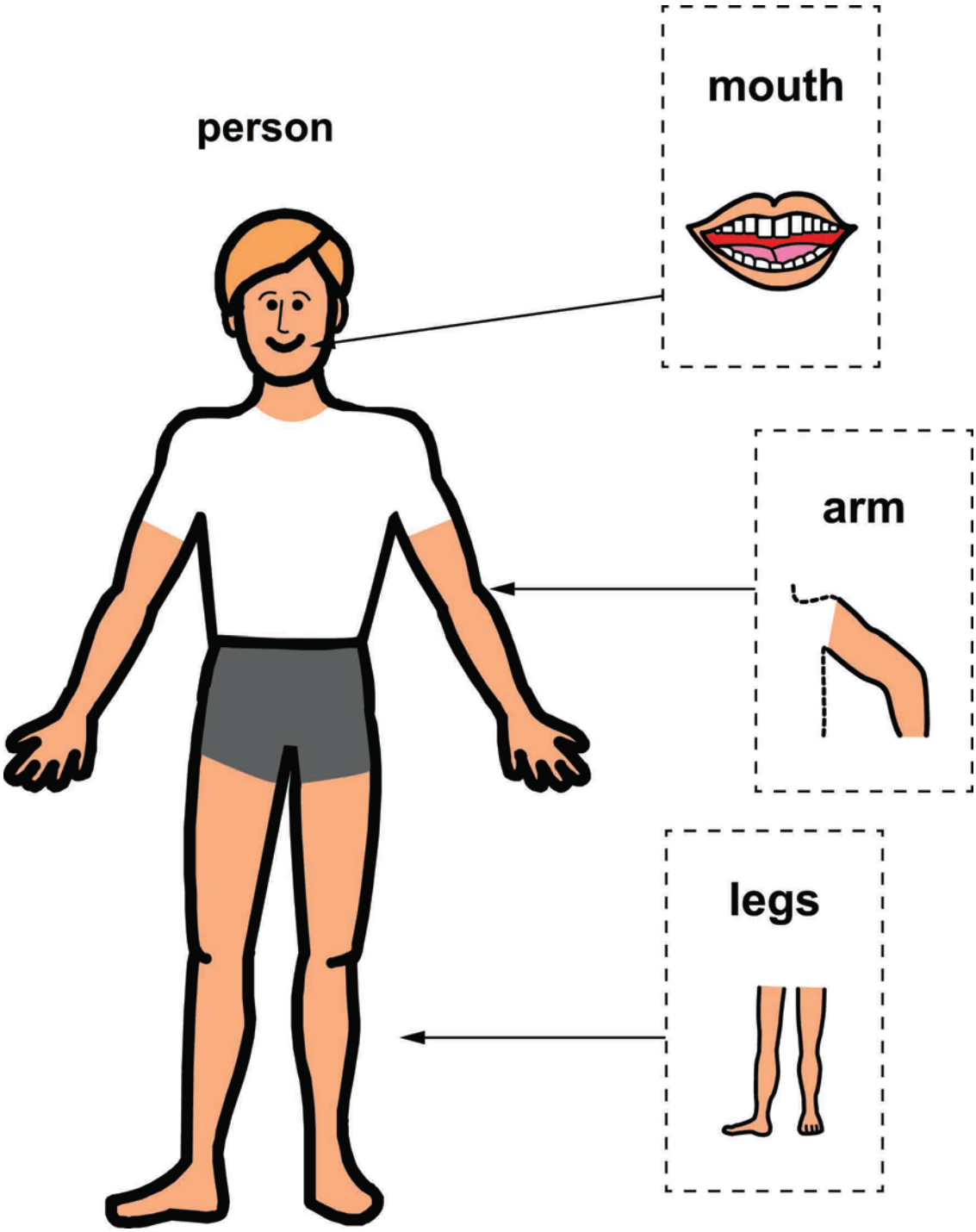
Most Complex ←		→ **Least Complex**
K.L.2A.1 (a) Obtain information and use observations to sort things in the environment as living (i.e., animal or plant) and non-living (e.g., air, water, food, shelter, or space).	K.L.2A.1 (b) Use observations to identify things as living (i.e., plant or animal) and non-living based on needs (e.g., air, water, food).	K.L.2A.1 (c) Identify a living thing.
K.L.2A.2 (a) Investigate to determine what plants need to survive (e.g., air, water, shelter).	K.L.2A.2 (b) Predict or describe what happens to plants with or without light. Identify that plants need light to survive.	K.L.2A.2 (c) Identify sources of light that plants can use to survive.
K.L.2A.3 (a) Use models to identify common body parts (e.g., mouths/beak, claws, tongues, noses, gills, shells, teeth, scales, tails) animals use to obtain food and water, for protection, and for movement.	K.L.2A.3 (b) Use illustrations to identify common body parts animals use to obtain food and to move.	K.L.2A.3 (c) Match the body parts animals use to obtain food and move.
K.L.2A.4 (a) Match five senses of common animals to affiliated body parts.	K.L.2A.4 (b) Use illustrations to identify the five senses of humans and the body part.	K.L.2A.4 (c) Identify a sense.
K.L.2A.5 (a) Investigate to explain what plants and animals need to survive.	K.L.2A.5 (b) Investigate to identify what plants and animals need to survive.	K.L.2A.5 (c) Identify three things that organisms need to survive.
K.L.2A.6 (a) Obtain information to identify areas where animals can live based on their needs.	K.L.2A.6 (b) Obtain information to sort animals based on the areas in which they live.	K.L.2A.6 (c) Match an animal to where it lives (e.g., fish to water, bears to forests).

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

K.L.2A.3 (b) Use illustrations to identify common body parts animals use to obtain food and to move.

- Students will identify the body parts used for eating and movement among mammals, birds, and fish.

- Begin by discussing the parts of the body that people use to move and eat. We have legs and feet that we use to walk. We can also use our arms to help us move around and pick up objects. We use our mouths to eat. Our mouths also have special structures called teeth and a tongue.
- Using the picture symbol for person projected or displayed on a poster, label the parts we use for moving—legs and arms—with the legs and arms picture symbols (or use real images). Then label the part we use for eating—the mouth—with the mouth picture symbol (or use a real image). This will be a model for identifying body parts on other animals. An example is shown:



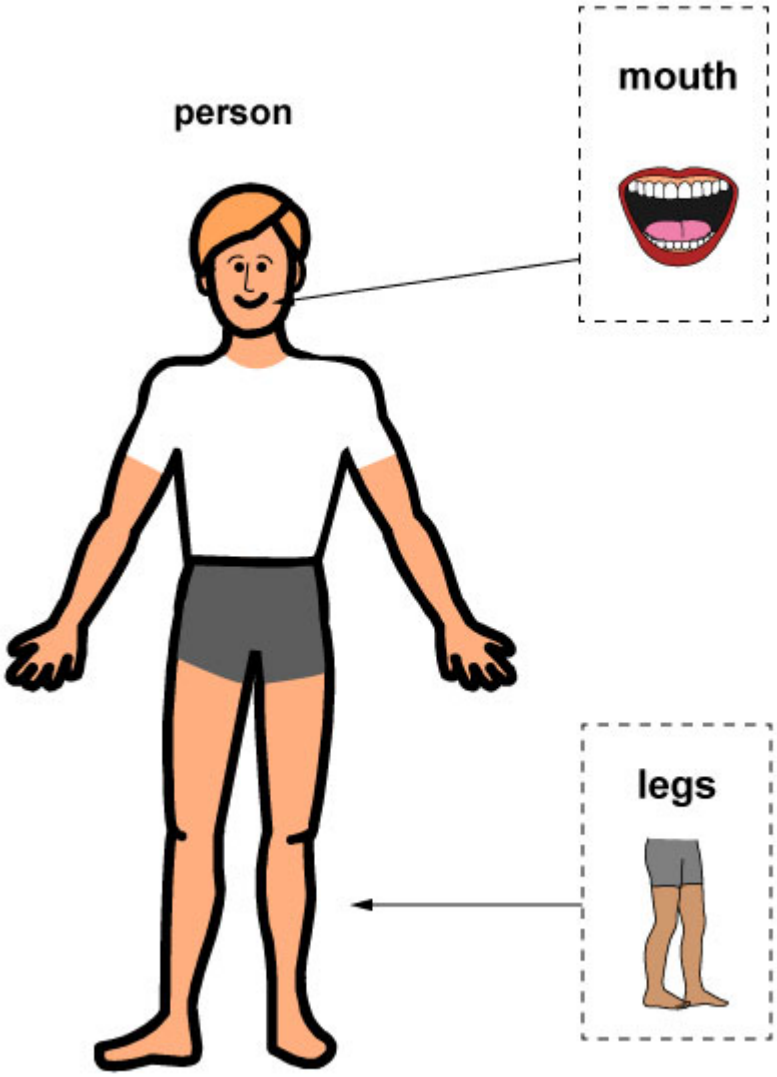
  - Play a game of “Simon Says.” Have students point to or hold up the part of the body you call out. You might say, “Simon says Touch your mouth,” “Simon says Raise your arms,” or “Simon says Lift your legs.” Students who have limited mobility can point to parts of their body, or use the poster you labeled as a class.

- Next, introduce an animal familiar to students, such as a dog, cat, or class pet. Instruct students that although this animal may look different from humans, the animal also needs to move and eat food. For example, a cat has four legs while a human has two. Cats have a special external structure called a tail to help maintain their balance. Cats also have teeth that help them shred food into small pieces for eating.
- Using the picture symbol for cat projected or displayed on a poster, label the parts that cats use for moving—legs and tail—with the legs and tail picture symbol. Then, label the part they use for eating—teeth—with the teeth picture symbol.
  - Using the picture symbol for tiger, label the legs and tail, and then the teeth. Choose other felines familiar to the students that have easily recognizable legs, tails, and teeth such as a lion, leopard, and cheetah for them to label.
- Next introduce fish. Fish cannot walk because they do not have legs, but they still need to move and eat. Fish have fins that they use for swimming, and they have mouths to eat.
- Using the picture symbol for fish projected or displayed on a poster, label the fish’s fins using the fins picture symbol, and then label the fish’s mouth with the mouth picture symbol.
  - Using the picture symbol for goldfish, label its fins and then its mouth. Choose other fish familiar to the students such as tropical fish, shark, and catfish for them to label.

Activity adaptation for less complexity

K.L.2A.3 (c) Match the body parts animals use to obtain food and move.

- For a less complex activity, you can discuss the body parts of humans and animals and label the arms, legs, mouths, beaks, and fins.
- Begin with the same discussion about the parts of the body that people use to move and eat. Display a large picture symbol for person, and point to the mouth. Next, show students a picture symbol for mouth. Have one student place the picture symbol for mouth directly on the mouth of the picture symbol for person. Next, show students a picture symbol for legs. Have another student place the picture symbol for legs directly on the legs of the picture symbol for person. Your poster may end up looking something like this:



- Allow students to apply their knowledge by having them use the previous steps to label the mouth and legs of an animal, such as a cat. For example, you might begin by displaying a large picture symbol for cat. Then, point to the cat's mouth. After that, show students a picture symbol for mouth. Have one student place the picture symbol for mouth directly on the mouth of the picture symbol for cat. Next, show students a picture symbol for legs. Have another student place the picture symbol for legs directly on the legs of the picture symbol for cat.
- Extend students' learning by having them match an action to the body part that performs that action. Make a T-chart and label the left column "Body Part" and the right column "Action." Put a picture symbol of a person above the T-chart as reference. Pre-place the picture symbols for mouth and legs in the "Body Part" column. Show students the picture symbols for eat or eating and move or moving. Ask them what action the mouth helps us do: eat or move (eat). Have one student place the picture symbol for eat or eating in the "Action" column, adjacent to the picture symbol for mouth. Next, ask students what action the leg helps us do: eat or move (move). Ask another student to put the picture symbol for move or moving in the "Action" column, adjacent to the picture symbol for legs. Your poster may end up looking like this:

Body Part	Action
mouth	eat
legs	move

- Allow students to apply their knowledge by having them repeat the previous process. This time, put a picture symbol of a cat above the T-chart as a reference.
- Help students make a personal connection between their body parts and what actions the body parts help us perform. You may choose to do the following with your entire class:
  - Sing the song, "Head, Shoulders, Knees and Toes," making sure each student touches the correct body part as they sing, or identify that body part on a picture symbol of a person.
  - During snack time, ask students what action they are performing. Are they eating? What part of their body are they using to eat their snack?
  - While walking through the school or to the playground, ask students what action they are performing. Are they walking? What part of their body are they using to walk?

<u>Activity adaptation for more complexity</u>

K.L.2A.3 (a) Use models to identify common body parts (e.g., mouths/beak, claws, tongues, noses, gills, shells, teeth, scales, tails) animals use to obtain food and water, for protection, and for movement.

- For a more complex activity, students will answer the question, "What does this animal use to…?" with descriptions when given an image of an animal.

- Begin by discussing how humans move, find food, and eat food. We have our arms and legs, which help us move. We use our noses to smell food, and our eyes to see food. We use our mouths, which have teeth and a tongue, to eat the food. Many animals have these same body parts. Some animals also have structures to protect themselves from other animals that want to eat them.
- Show students a picture symbol or a real image of a turtle. Ask the students, "What does this animal use to…:
  - …move?" Its arms and legs.
  - …find food?" Its ears, nose, and eyes.
  - …eat food?" Its mouth.
  - …protect itself?" Its shell.
- Continue this activity with other animals that have specialized structures for protecting themselves, such as an alligator's scales, porcupine's quills, and rhinoceros's horn.

<u>Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities</u>

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

K.L.2A.2 (b) Predict or describe what happens to plants with or without light. Identify that plants need light to survive.

- Students will observe how light affects plants.
- Begin by observing plants outdoors. Remind students that plants need water and light to survive. They get water from rain, and light from the sun.
- Use two simple green-leaf plants. Place one plant in an area of the classroom where it is dark, and place the other plant in an area of the classroom where it will receive light (from the sun or a lamp).
- Explain to students that we need to water plants that are kept indoors because it rains only outdoors. Every three days, allow one student to water the plant placed in the dark and another student to water the plant placed in the light. Use the same amount of water for each plant.
- Each morning or afternoon, show students the two plants and give them time to touch and feel the plants. Have students keep a Science Journal in which they record their observations, noting any similarities or differences between the plants. Students can do this by drawing, sketching, writing, or gluing picture symbols in their journals.
- After several weeks, compare the plants side by side. Remind students that each plant received the same amount of water with the same frequency. However, the only difference between each plant is the amount of sunlight. Discuss with students what happens when plants do not get the sunlight they need.

Kindergarten

Core Concept: Earth Science: Exploring Weather Patterns

It is essential for students to know: Weather conditions vary based on the part of the country or world in which a person lives (K.E.3A.1). Weather changes follow a pattern called seasons. There are four major seasons that occur in year (K.E.3A.2). The change of seasons results in different weather conditions in an area. These changes affect plants and animals (K.E.3A.3). Weather affects human activities (K.E.3A.4).

Most Complex ←		→ **Least Complex**
K.E.3A.1 (a) Use pictures of local weather conditions (e.g., temperature, wind, precipitation, cloud coverage) to describe weather patterns.	K.E.3A.1 (b) Use pictures to match local weather conditions (e.g., temperature and precipitation) to weather patterns.	K.E.3A.1 (c) Use pictures to identify a local weather condition (e.g., temperature or rain).
*K.E.3A.2 (a) Use models to predict and identify weather patterns during the seasons.	K.E.3A.2 (b) Use illustrations to describe types of weather changes during the seasons.	K.E.3A.2 (c) Identify types of short-term weather (e.g., rain, snow, clear).
K.E.3A.3 (a) Obtain information and use pictures to describe how seasonal changes affect plants and animals.	K.E.3A.3 (b) Use pictures to identify ways plants and animals are affected by changes in a season.	K.E.3A.3 (c) Use pictures to identify changes in a season (e.g., some trees lose leaves in winter).
K.E.3A.4 (a) Describe problems caused by the effects of weather on human activities and create solutions to solve the problem.	K.E.3A.4 (b) Match problems caused by the effects of weather to possible solutions (e.g., rain: use an umbrella).	K.E.3A.4 (c) Identify a weather condition that is a problem for human activities (e.g., rain).

Application of Performance Indicators at the Middle Level—Instructional Activities

K.E.3A.2 (b) Use illustrations to describe types of weather changes during the seasons.

- Students will use images to describe types of weather changes that occur during seasons.
- Teach students that each season is defined by certain weather conditions. Summer months are typically sunny. Fall months are typically windy. Winter months are typically snowy. Spring months are typically rainy.
- Teach students that seasons occur during specific months. The summer months are June, July, and August. The fall months are September, October, and November. The winter months are December, January, and February. The spring months are March, April, and May.
- Help students make a personal connection to the seasons by asking them when they were born. For students who do not observe birthdays, you could use the term “day you were born” instead of “birthday.” Record that information as a class using a large, 12-month calendar. Then, have a student place his or her picture on his or her birthday, with adult assistance if necessary. For example, if a student was born on January 1, he or she would put his or her picture on that date on the calendar. After the student places his or her picture on the calendar, say, “You were born on January 1. January is a winter month. Winter months are snowy.” Repeat these steps until each

student has placed a picture of his or her birthday on the calendar. Review students' work as a class so that they can see the range of seasons that the dates span. You might say, "Maisy was born on March 5. March is a spring month. Remy was born on June 26. June is a summer month."

- Use the class calendar to reinforce their knowledge of seasons and build upon their understanding of weather. Say, "Now we know what season we were born in. Let's go back and identify the weather that occurs during that season." You may want to repeat the information about weather conditions during each season. Summer months are typically sunny. Fall months are typically windy. Winter months are typically snowy. Spring months are typically rainy.
- Select a student's birthday to model this activity. You might say, "Jasmine was born on September 21. September is a fall month. We know that fall is a windy season. Let's put the word 'windy' next to Jasmine's name." Give each student the opportunity to select the weather that is typical of the season they were born in, and place that vocabulary word on the calendar beside their picture. Use picture symbols or photographs for the weather-related vocabulary words ("windy" for fall, "snowy" for winter, "rainy" for spring, and "sunny" for summer).
- You can choose other familiar events besides birthday to discuss seasons. Some suggestions include the first day of school, the last day of school, the beginning of winter/spring/summer vacation, or a school concert or play day.

<u>Activity adaptation for less complexity</u>

K.E.3A.2 (c) Identify types of short-term weather (e.g., rain, snow, clear).

- Students will use pictures to identify weather conditions.
- Introduce a variety of weather conditions to students. For example, show a picture of rainy conditions and say, "This picture shows rainy weather" or, show a picture of clear weather and say, "This picture shows clear weather." If you are outdoors with your class, make a verbal observation of the weather and pair it with a picture symbol.
- After teaching them a variety of weather conditions, test students' knowledge. Depending on the needs and abilities of your students, you may show the images one at a time or in sets of two or three. If you present only one picture, you might ask, "What type of weather does this picture show?" If you present two or three pictures at a time, you might ask, "Which picture shows snowy weather?"

<u>Activity adaptation for more complexity</u>

K.E.3A.2 (a) Use models to predict and identify weather patterns during the seasons.

- For students who have the skills to go further, include temperature as component of weather patterns within each season.
- Teach students that each season is defined by certain weather conditions. Summer months are typically sunny; the temperature is usually hot. Fall months are typically windy; the temperature is usually cool. Winter months are typically snowy; the temperature is usually cold. Spring months are typically rainy; the temperature is usually warm.
- Have students apply this information by matching weather patterns (conditions and temperature) to the appropriate season. For example, create a four-column chart, labeling each column with a season. Prompt students by showing them a picture symbol of a weather condition and asking

them which season it belongs to. You may present the question in an open-ended format (e.g., "Which season is hot?") or you could ask students to choose between two seasons (e.g., "Which season is hot: summer or winter?"). Have students place the picture symbol of that weather condition under the correct season on the chart. After giving each student a turn, review the completed chart as a class.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

K.S.1A.4 Analyze and interpret data from observations, measurements, or investigations to understand patterns and meanings.

K.E.3A.3 (b) Use models to predict and identify weather patterns and the season when that weather occurs.

- Students will identify weather patterns and seasons.
- Place a thermometer outside in a safe, open area of the school playground (where shade or trees will not block the thermometer's measurement).
- At the start of the school day, lead the students through making verbal weather observations. Create a chart stating the conditions outside (e.g., sunny, cloudy, partly sunny, foggy) and with lines for writing down the temperature, the precipitation seen (e.g., rain, snow, hail, sleet, wind), and for how it feels outside. Have one student be the recorder of the day's weather using this chart.
- Go the window (or outside the classroom or school, weather permitting) to notice the conditions of the weather (e.g., sunny, cloudy, partly sunny, foggy, etc.). Have them take note of the feel of the temperature outside (if the students are taken outside).
- Lead the students over to the thermometer you placed outside. Talk about how it feels outside and connect the feeling to the temperature.
- Repeat this process each day for three days.
- On the fourth day, give each student a blank copy of the weather chart the recorder was using on the previous days. Guide students through making their own observations by selecting options on each line of the chart, and from reading the thermometer.
- After the fifth or sixth day of conducting this activity, have students make predictions of what the weather will be for the day each morning. Make a tally chart on the board to record their predictions/choices. At the end of each school day, revisit the weather predictions and guide students through how they knew/what information they used to make good predictions.

Kindergarten

Core Concept: Physical Science: Exploring Properties of Objects and Materials

It is essential for students to know: Making observations is a way of learning about the world around us. Based on these observations, we can classify objects based on similarities and differences (natural or manmade) (K.P.4A.1). Objects are made of different materials. These materials have different properties (K.P.4A.2).

Most Complex ←		→ **Least Complex**
K.P.4A.1 (a) Use observations to classify objects based on similar properties (e.g., size, shape, color, texture, weight, flexibility, attraction to magnets, or ability to float/sink in water).	K.P.4A.1 (b) Use observations to classify objects based on one property (e.g., same size, same shape).	K.P.4A.1 (c) Use observations to identify a property of an object (e.g., the ball is large, the rock is smooth).
K.P.4A.2 (a) Use models and observations to describe properties of different materials (e.g., wood, plastic, metal, cloth, and paper) and classify them by their observable properties, by their uses, and if they are natural or man-made.	K.P.4A.2 (b) Use models and observations to classify different materials based on their properties and uses (e.g., wood furniture, toys, pencils) and if they are natural or man-made.	K.P.4A.2 (c) Identify different materials (e.g., cloth, paper).

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

K.P.4A.2 (b) Use models and observations to classify different materials based on their properties and uses (e.g., wood furniture, toys, pencils) and if they are natural or man-made.

- The goal of this lesson is for students to recognize materials based on properties.
- Begin by introducing objects made of wood, metal, and cloth such as a pencil, metal bolt, and washcloth. Allow the student to feel the objects, look closely at them, and attempt to bend each one to make as many observations as possible.

- Create a three-column table. Label the first column “Wood,” the second column “Metal,” and the third column “Cloth.” Pair each heading with a picture symbol or photograph of that word. An example of the chart is shown:

Wood	Metal	Cloth

- Show students picture symbols or photographs of products made from the three different materials (e.g., desk, rug, sweater, socks, pencil, door handle, scissors, key).
- Pass a picture card of the different objects to each student. Have students place the image of each object in the column based on the material used to create it.
- Discuss how each product is man-made (needs to be put together by someone or a machine) or natural (you can find it in nature).

<u>Activity adaptation for less complexity</u>

K.P.4A.2 (c) Identify different materials (e.g., cloth, paper).

- For students who may require additional support, have them identify materials they may encounter on a daily basis.

- Begin by showing students objects made of paper or metal, such as a sheet of paper and a metal bolt. Allow students to feel the objects, look closely at them, and maybe try to bend each one to make as many observations as possible.
- Create a T-chart, or use bins or trays for sorting objects. You could also use two hula hoops to sort objects (place the hula hoops on the ground or prop them against a chalkboard). Label the first column "Paper" and the second column "Metal." Pair each heading with a picture symbol of that word.
- Show students picture symbols of objects made from paper or metal (e.g., door handle, scissors, key, bell, notepad, sticky paper, book). Allow students to study the images to determine whether the objects were made from paper or metal. Have students place the picture symbols in the column based on the material used to make it.

Activity adaptation for more complexity

K.P.4A.2 (a) Use models and observations to describe properties of different materials (e.g., wood, plastic, metal, cloth, and paper) and classify them by their observable properties, by their uses, and if they are natural or man-made.

- For students with the skills to go further, create two charts with two columns each. You may also use bins or trays to sort the objects in this activity, making sure to label them. If using a chart, label the columns of the first chart "Soft" and "Hard." Label the columns of the second chart "Natural" and "Man-Made."
- Create two sets of picture symbols of objects with hard or soft textures (e.g., pencil, chair, hat, gloves, book, stones, leaves, flower petals, stuffed animal). Give students time to study the picture symbols to determine the texture of the object and whether it is natural or man-made.
- Using one set of picture symbols, have students place the each one in the corresponding column of the physical properties chart. As students place the picture symbols in the columns, extend their learning by asking them what detail about the product makes them think it belongs in that column.
- Using the other set of picture symbols, repeat the activity using the second chart.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

K.S.1A.4 Analyze and interpret data from observations, measurements, or investigations to understand patterns and meanings.

K.P.4A.1 (b) Use observations to classify objects based on one property (e.g., same size, same shape).

- Students will learn to test the properties of objects and then apply their tests to classify various objects based on shape and size.
- Materials:
  - A ball
  - A block
  - A marker
  - A poster
  - A long piece of string or yarn

- Starting with the property of shape, tell students that they are going to find objects that are round. They know objects are round when they can roll easily. Roll a ball to show students that a ball rolls easily. That is how we know it is round. Next, try to roll a block. The block does not roll easily because it is not round.
- Have students collect objects around the classroom that roll (e.g., markers, pencils, other balls, cups with no handles). Next, have students determine that the objects are round by rolling them on the floor.
- The next property students will explore is length. Give each student a piece of yarn or string approximately 8 inches in length. Stand a marker on a desk. Hold one end of the string to the desk, next to the marker. Stretch the other end of the string vertically. Tell students that the marker is shorter than the string. Next, compare the length of the string to the length of a poster. Hold one end of the string at the corner of the poster and extend the string along the edge of the poster. Tell students that the side of the poster is longer than the string.
- Task the students with finding objects around the classroom that are shorter or longer than the string. Have them use the string to show how the objects are longer or shorter.

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Age 6 on or before September 1 (Grade 1)

First Grade

Core Concept: Physical Science: Exploring Light and Shadows

It is essential for students to know: In order for an object to be visible, it must either give off its own light (be a source of light) or it must reflect light. If there is no light, then it is impossible to see an object. The sun, a candle flame, or a flashlight gives off visible light. The moon and many objects around us reflect light in order to be seen. (1.P.2A.1). Depending on the type of object, all, some, or no light can pass through (1.P.2A.2). The position of a light source affects the appearance of a shadow. Shadows can change size and location depending on the position (1.P.2A.3).

Most Complex ←		→ **Least Complex**
1.P.2A.1 (a) Use models to describe how light is needed to see and reflect off objects.	1.P.2A.1 (b) Use models to explain why light is needed to see and reflect off objects.	1.P.2A.1 (c) Identify objects that give off light (e.g., sun, light bulb).
1.P.2A.2 (a) Use models and observations to compare how light behaves (all, some, or none of the light passes through) when it shines on different materials.	1.P.2A.2 (b) Use observation to sort materials based on whether or not they allow light to pass through.	1.P.2A.2 (c) Identify whether or not light passes through an object (e.g., glass and cardboard).
1.P.2A.3 (a) Investigate and use models to describe how shadows change when the position of the light source changes (e.g., distance/size, position/location).	1.P.2A.3 (b) Identify changes in shadows (e.g., longer, shorter).	1.P.2A.3 (c) Identify a shadow.

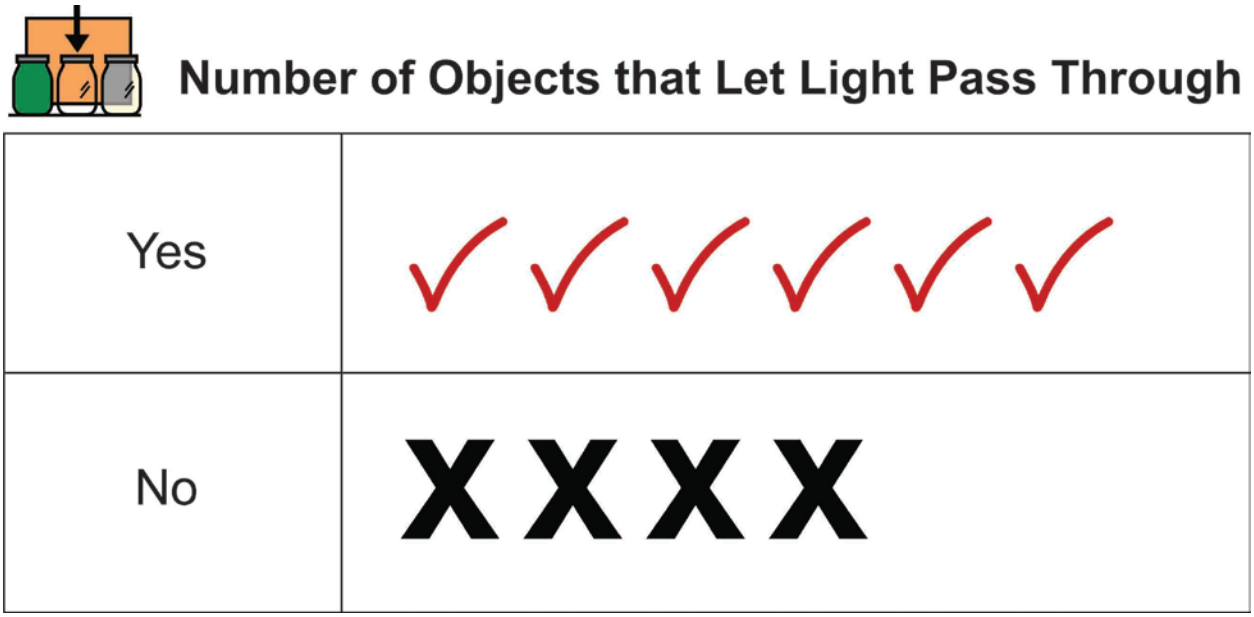
Application of Performance Indicators at the Middle Level—Instructional Activities

1.P.2A.2 (b) Use observation to sort materials based on whether or not they allow light to pass through.

- Students will categorize objects by whether light can pass through them.
- Begin by demonstrating with a clear glass or jar that has something visible inside it. Ask students, “Can you see something inside the glass?” The answer is yes because the glass allows light to pass through it. Then show the students a metal can (such as a coffee can) with something inside it. Can they see what is inside? No, because the can is made of a material that does not allow light to pass through it.
- Provide a copy of the following exemplar list of objects for the student to examine. The objects may be paired or substituted with picture symbols. Leave the left column blank. Have the students place an X next to the materials that allow light to pass through.

Does light pass through?	Object
X	Window
X	Clear plastic cup
	Coffee mug
	Construction paper
X	Plastic water bottle
	Door with no window
X	Magnifying glass
X	Eye glasses
	Cardboard box
X	Plastic sandwich bag

- To extend the activity further, have students graph the data they collected. This will help students compare their results visually. Ask follow-up questions, such as "Which do we have more of: objects that let light pass through or objects that do not let light pass through?" or, "How many objects let light pass through?" Your pictograph may end up looking something like this:



  Next, look at some of the objects and discuss why it is important for light to pass through them. For example, we need to be able to see through a window so that we know what the weather is like outside. Having containers that allow light to pass through them lets us see what is inside or how much of something is left. It is especially important for light to pass through eye glasses and magnifying glasses because they are meant to help us see things clearly.

- This may lead to a more challenging discussion about why we would choose objects that do not allow light to pass through them. For example, we might use a cardboard box because we want to hide what is inside, or we may choose a door with no windows because we want to block too much light from coming into a room.

<u>Activity adaptation for less complexity</u>

1.P.2A.2 (c) Identify whether or not light passes through an object (e.g., glass and cardboard).

- For students who need more support understanding the concept of light passing through an object, you could create a hands-on demonstration using a flashlight.
- Begin by explaining that some materials allow light to pass through them, while other materials do not. Darken the room and turn on a flashlight. Note that the flashlight is producing light. Now, hold a book up against the flashlight. Is the beam of light coming out the other side of the book? The answer is no because light cannot pass through a book.
- Continue the demonstration with the flashlight using the list of materials in the previous section. You could also check for understanding by having students use Yes/No sticks to answer a question. For example, you might ask, "Does light go through the cardboard box?" The answer is

no; students should hold up the No stick. Yes/no sticks can be made from popsicle sticks. Yes can be a thumbs-up symbol or a round circle, and No can be a thumbs down symbol or a square.

Activity adaptation for more complexity

1.P.2A. 2 (a) Use models and observations to compare how light behaves (all, some, or none of the light passes through) when it shines on different materials.

- For a more complex activity, students will observe both solid and liquid materials that allow all light to pass through, some light to pass through, and no light to pass through.
- Begin by explaining that a glass window allows light to pass through it. This is why we can see everything on the other side of a window. Hold up a sheet of wax paper with an object behind it. The students should see that there is an object, but it is not very clear. This is because wax paper only allows some light to pass through it. Next, hold up a piece of construction paper with an object behind it. Can the students see through the construction paper? No, because construction paper does not allow light to pass through it.
- Present students with three different liquids in clear plastic cups, with each cup containing a straw. The first cup should have plain water, the second cup should have water with food coloring, and the third cup should have milk.
  - Can the students see the straw clearly in the cup of water? (Yes) Does the cup of water allow light to pass through it? (Yes) Which is water like: the window, wax paper, or construction paper? (Window) The straw can easily be seen in the cup of water because the water allows light to pass through it, just like the window.
  - Can the students see the straw clearly in the cup of colored water? (No, not clearly) Does the cup of colored water allow light to pass through it? (Yes, some) Which is colored water like: the window, wax paper, or construction paper? (Wax paper) The straw can be seen in the cup of colored water but not as easily as the plain water. This is because the colored water allows some light to pass through it just like the wax paper.
  - Can the students see the straw clearly in the cup of milk? (No) Does the cup of milk allow light to pass through it? (No) Which is milk similar to: the window, wax paper, or construction paper? (Construction paper) The straw cannot be seen in the cup of milk because the milk does not allow light to pass through it, just like the construction paper.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

1.S.1A.1 Ask and answer questions about the natural world using explorations, observations, or structured investigations.

1.P.2A.3 (b) Identify changes in shadows (e.g., longer, shorter).

- Gather a flashlight and long and short objects that have a flat surface that allows them to stand on their own (e.g., building block, marker, crayon, book).
- Explain to students how moving a light source away from and closer to an object can change the size of the object's shadow. Placing a light source close to an object will make its shadow appear larger, while moving a light source away from an object will make its shadow smaller.

- Turn off the lights in the classroom and place the objects in a location where students can clearly identify and observe the changes in an object's shadow. You may choose to place the objects near a wall to observe shadows on a wall rather than on the ground. Turn on the flashlight and point it at an object, such as a standing marker. Then, move the light closer to and farther away from the object. Observe the shadow behind the marker. How does the shadow change when the flashlight is close to the marker? When it is far away?
- Continue the experiment as a class. Give each student a turn at repeating the process you modeled. Have students select an object and move the flashlight closer to the object to make its shadow grow larger. Then have the students move the light source away to see how the shadow becomes smaller.
- After each student's turn, record their observations on a three-column table. Label the first column "Object," the second column "Close," and the third column "Far." Pre-place picture symbols of each object used in this investigation (e.g., building block, marker, crayon, book) in the first column. Make cards that show a large or a small shadow of each object. Show these cards to students and have them select which shadow belongs in the "Close" or "Far" column after moving the flashlight close to or far away from the object. For example, if a student holds a flashlight close to a book, hold up two cards: one showing a large shadow of the book, and another showing a small shadow of the book. You might say, "You placed the flashlight close to the book. What size was the book's shadow?" The student should select the large shadow and put in the "Close" column. The table might end up looking like this:

Object	Close	Far
Book		
Marker		

- After completing the investigation, help students make a conclusion about the relationship between the size of an object's shadow and its distance from a light source.

First Grade

Core Concept: Earth Science: Exploring the Sun and Moon

It is essential for students to know: The sun appears to rise and set, and move across the sky during the day due to the Earth's rotation (1.E.3A.1). The moon circles the Earth once a month and appears to change shapes as it moves (1.E.3A.2). The sun is a star that provides energy in the form of heat and light (1.E.3A.4). The sun provides warmth and light to the Earth's surfaces. The more direct sunlight an area receives, the warmer the temperature in that area (1.E.3A.5).

Most Complex ←		→ **Least Complex**
1.E.3A.1 (a) Use data to identify seasonal patterns of sunrise and sunset objects in the day sky (e.g., sun, clouds, birds, planes).	1.E.3A.1 (b) Identify patterns to identify seasonal patterns of sunrise and sunset objects in the day sky (e.g., sun, clouds, birds, planes).	1.E.3A.1 (c) Use pictures to identify day and night and seasons.
1.E.3A.2 (a) Use pictures or models to describe and predict how the appearance of the moon changes over time.	1.E.3A.2 (b) Use models to identify the shape of the moon.	1.E.3A.2 (c) Identify the sun, the moon, and the Earth.
1.E.3A.4 (a) Investigate to answer questions about the effects of sunlight (warmth and light) on the Earth's surface.	1.E.3A.4 (b) Identify the properties of the sun (warmth and light).	1.E.3A.4 (c) Recognize that the sun warms an object.
1.E.3A.5 (a) Define problems related to the warming effect of sunlight and create a solution (e.g., move under shaded tree or umbrella) to reduce its impact on a particular area.	1.E.3A.5 (b) Describe objects (e.g., umbrella, tree) that can shield the sun's heat and light.	1.E.3A.5 (c) Identify an object that shields the heat of the sun (e.g., umbrella, tree).

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

1.E.3A.2 (b) Use models to identify the shape of the moon.

- The goal of this lesson is for students to identify two familiar shapes that the moon makes, a circle and a half-circle.
- Introduce the lesson by reading a book about the moon. One suggestion is *Papa, Please Get the Moon for Me* by Eric Carle.
- Tell students that the moon appears to change its shape slowly throughout the month. The shapes help us determine what phase the moon is in. When the moon appears as a circle, this is called a full-moon phase. When the moon appears as a half circle, this is called a quarter moon phase.
- Show students paper cut-outs of a circle and a half-circle. Practice identifying each shape by asking, "Which one is a circle?" or, "Which one is a half-circle?" To extend students' knowledge, ask students to identify the phase of the moon that each shape represents. For example, you might ask, "Which shape represents a full moon?" or, "Which shape represents a quarter moon?"

Activity adaptation for less complexity

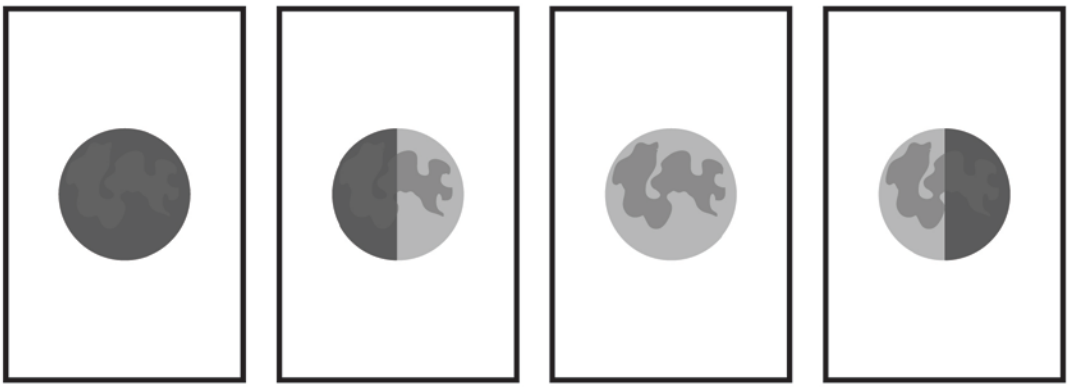
1.E.3A.2 (c) Identify the sun, the moon, and the Earth.

- For students who need additional support, focus on identifying the sun, the moon, and the Earth.
- Begin by describing the relationship between the sun, the moon, and the Earth. Explain that the sun is stationary. The Earth moves around the sun. The moon moves around the Earth.
- Have students take turns acting out the rotation of the moon around the Earth, and the Earth around the sun. Obtain three balls representing each of these objects in space: an orange or yellow ball representing the sun, a gray or white ball representing the moon, and a blue or green ball representing the Earth. Have the student holding the orange or yellow ball stand or sit in a chair. Have the student holding the blue or green ball walk slowly around the sun. Have the student holding the gray or white ball walk slowly around the Earth. Depending on the abilities of your students, you may choose to act out the movement of the Earth and moon simultaneously or one at a time.

Activity adaptation for more complexity

1.E.3A.2 (a) Use pictures or models to describe and predict how the appearance of the moon changes over time.

- For students who have the skills to go further, have them complete a pattern to predict how the moon changes over time.
- Teach students that the moon appears to slowly change shape during the course of a month. The moon goes through phases that we can predict. The four phases of the moon are called new moon, first quarter moon, full moon, and third quarter moon. Show students pictures of each phase of the moon. Ask them to identify each phase.
- Extend students' learning by having them identify which phase of the moon comes next. Alternatively, you could ask students which phase comes first, second, third, or last. If using the first scenario, begin by showing students the first three phases of the moon (new moon, first quarter moon, and full moon). Ask students what phase comes next (third quarter moon). Repeat the same process, asking students to identify another missing phase of the moon. To extend the activity further, ask to identify two missing phases of the moon. An example of four consecutive phases of the moon are shown:



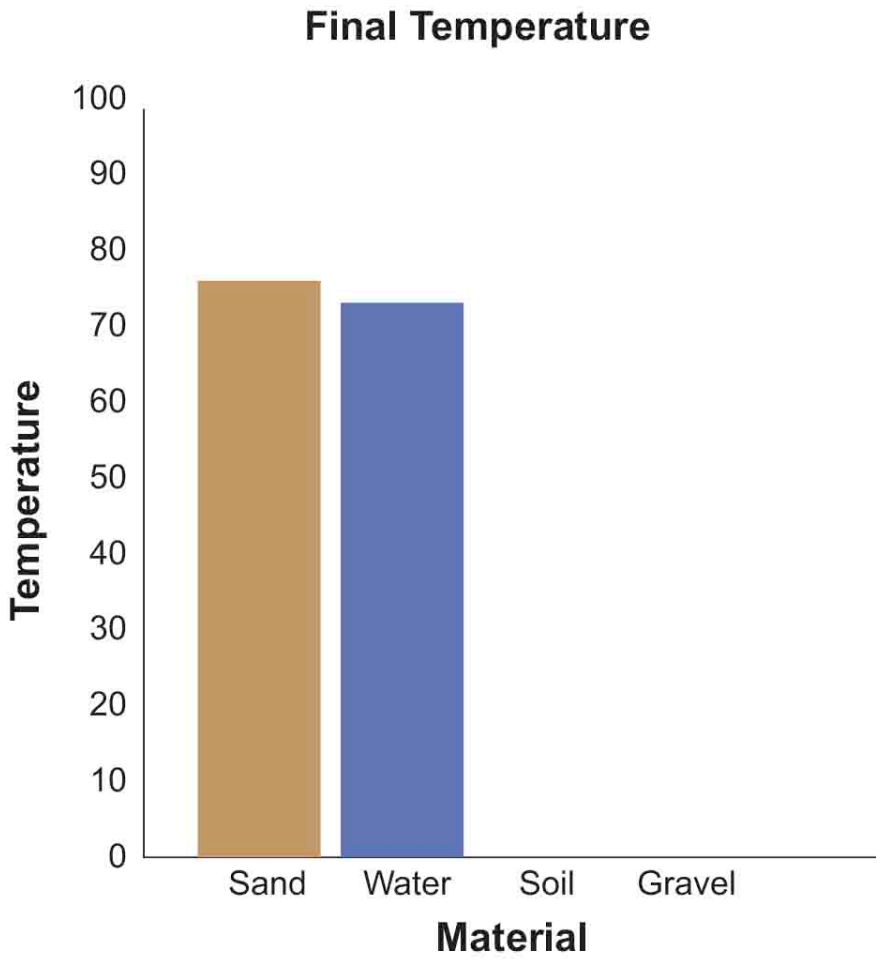
Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

1.S.1A.1 Ask and answer questions about the natural world using explorations, observations, or structured investigations.

1.E.3A.4(a) Investigate to answer questions about the effects of sunlight (warmth and light) on the Earth's surface.

- Students will demonstrate and observe the effects of sunlight on the Earth's surface.
- Materials:
  - 4 plastic cups
  - Sand
  - Water
  - Soil
  - Gravel
  - Marker
  - Thermometer
  - Clock
  - Science Journals
  - Chart paper
- Prepare the plastic cups before starting the investigation. Label one cup "Water," another cup "Sand," the third cup "Soil," and the last cup "Gravel." Fill each cup at least half way with the corresponding material.
- Begin the investigation by activating prior knowledge. Tell students how the sun is important. It supplies energy to the Earth's surface. It provides solar energy in the form of heat and light. The sun heats the Earth's surface and atmosphere. The sun affects the Earth's environment.
- Next, show students a picture of a playground. Ask them to think about what it would feel like to play on the playground on a sunny, spring day? Warm or cool? (Warm). Ask them what would cause them to feel warm. (The sun shining)
  - Procedure:
    - **Day 1: Water and Sand**
      1. Show students the cups labeled "Water" and "Sand."
      2. Use the thermometer to take the temperature of each cup.
      3. Have students record the temperatures in their Science Journals.
      4. Next, have students put the two cups in the sunlight (this may be in a sunny window sill or outdoors). Both cups must be exposed to sunlight.
      5. Have students record the starting time in their Science Journals.
      6. After 10 minutes, have students use the thermometer to take the temperature of each substance. Have them record the temperature in their Science Journals, noting the time again.
      7. Record the temperature of each material every 10 minutes for an hour.

8. Finally, as a whole class, create a bar graph on chart paper showing the final temperature reading of each material. Label the x-axis “Material” (the bars should be marked “Sand,” “Water,” “Soil,” and “Gravel”). Label the y-axis “Temperature.” Your bar graph may end up looking like this:



- **Day 2: Soil and Gravel**
  1. Review what was learned from Day 1.
  2. Repeat steps 1–8, using the soil and gravel cups. Complete the bar graph by adding the temperature data for soil and gravel.

- Summarize the lesson by discussing how the sun affects the Earth’s surface. Based on the investigation, students may note that materials on Earth’s surface absorb sunlight at different rates. Water will take longer to absorb heat, but it will retain heat for much longer.

First Grade

Core Concept: Earth Science: Exploring Earth's Natural Resources

It is essential for students to know: The Earth is made up of different materials, including rocks, sand, soil, and water. These materials are all resources of the Earth (1.E.4A.1). These materials are distributed in the form of land and water on the Earth's surface. Water is classified into different bodies of water depending on characteristics, including whether it is fresh or salt water (1.E.4A.2). The Earth's materials can be used for building structures or for growing plants (1.E.4B.1). Natural resources are those that come from the Earth and cannot be made. Because of this, they are limited and people try to use them carefully or reuse them. Some natural resources are reused through the recycling process (1.E.4B.2).

Most Complex ←		→ **Least Complex**
1.E.4A.1 (a) Use observational data to compare properties (e.g., size, shape, color, rough, smooth, wet, salty) of the Earth's materials (e.g., rocks, soils, sand, water).	1.E.4A.1 (b) Use observational data to sort the Earth's materials (e.g., rocks, soils, sand, water) based on physical properties.	1.E.4A.1 (c) Identify a type of the Earth's material as rock, sand, or water.
1.E.4A.2 (a) Use models to describe patterns in the distribution of land and water on the Earth and compare different bodies of water (e.g., oceans, lakes, ponds, rivers, and streams).	1.E.4A.2 (b) Use illustrations to classify bodies of water based on their characteristics (e.g., saltwater and freshwater).	1.E.4A.2 (c) Use maps to identify land or bodies of water.
1.E.4B.1 (a) Use data to describe different ways natural resources are used.	1.E.4B.1 (b) Match the Earth's materials to the way they could be used (e.g., soil and water to grow plants, rocks to build roads).	1.E.4B.1 (c) Identify a natural resource.
1.E.4B.2 (a) Use data to explain ways natural resources can be conserved.	1.E.4B.2 (b) Sort objects as trash and recyclables (e.g., plastic, paper, glass).	1.E.4B.2 (c) Identify objects that could be recycled.

Application of Performance Indicators at the Middle Level—Instructional Activities

1.E.4A.2 (b) Use illustrations to classify bodies of water based on their characteristics (e.g., saltwater and freshwater).

- Students will use a map to classify bodies of water based on their characteristics.
- Begin by discussing some characteristics of bodies of water. Bodies of water can be classified into different categories, such as saltwater/freshwater, type, or size. Landforms are color-coded on a physical map. Water is usually indicated with blue, while other colors indicate land elevation, with green typically used for low elevations.

- Select one characteristic of bodies of water (such as type) to focus on for this lesson, perhaps using a local example as a point of reference. Project a blank map of your state on the board. The map should include the major bodies of water (e.g., lakes, rivers, oceans) in addition to landforms. Bodies of water appear in different forms, which is why they have different names. Rivers are typically freshwater sources that flow from high ground to another body of water, such as an ocean. Indicate a river on the state map and trace it with your finger. Tell students where the river originates (perhaps in a mountain range) and where it ends (perhaps an ocean). Ask a student to trace the river with a blue marker. Repeat the same process with each student, marking all major rivers on the state map.
- Next, identify another body of water, such as a lake. A lake is usually a body of freshwater that is entirely surrounded by land. Locate a lake on the state map and trace its outline with your finger. Lakes appear in different sizes and shapes, but what makes them alike is that they are deep, and their water does not drain. Ask a student to trace the outline of the lake with a different color. Repeat the same process with each student, marking all major lakes on the state map.
- Finally, locate the ocean on the map. An ocean is the largest body of saltwater. Trace the coastline to designate where the ocean meets the land.

<u>Activity adaptation for less complexity</u>

1.E.4A.2 (c) Use maps to identify land or body of water.

- For a less complex activity, students will identify the natural features of the Earth's surface as landforms or bodies of water.
- Begin with the same discussion about bodies of water. The Earth is covered mostly with water, the largest being oceans. The remaining portion of the planet is covered with landforms, which are natural features that appear on the surface. These include mountains, plains, beaches, and peninsulas.
- You might want students to see and taste the difference between salt water and fresh water. You can make salt-water by mixing drinking water and sea salt. Students can also look at and touch the salt water and fresh water to compare their properties.
- You might also ask students' parents to take a picture of a landform or body of water near their home or in their neighborhood (e.g., a lake, a river, a forest). Have the student share the picture with the class and make a connection with it (e.g., What do you do at the lake? Do you go fishing at the river? Do you take walks through the forest?)
- Another idea is to access online satellite imagery on a computer. Locate major cities and attractions. Ask your students what landform or body of water is situated near it. For example, you might look up your state's capital and ask, "What body of water is located near the capital: a lake or a river?").

<u>Activity adaptation for more complexity</u>

1.E.4A.2 (a) Use models to describe patterns in the distribution of land and water on the Earth and compare different bodies of water (e.g., oceans, lakes, ponds, rivers, and streams).

- For a more complex activity, students will compare different bodies of water by playing a trivia game. You can create your own trivia cards or search online sources for ideas.

- Bodies of water appear in different forms, which is why they have different names. For example, rivers are typically fresh-water sources that flow from high ground to another body of water, such as the sea. Oceans are major bodies of salt-water that cover most of the surface of the Earth. Lakes are usually fresh water bodies that are entirely encompassed by land.
- Play a game of trivia as follows: Give each student the same set of picture symbols depicting different landforms and bodies of water. Read a clue about a landform or body of water. Students will select the correct answer to your clue using their set of cards. For example, one clue might be, "This body of water is surrounded by land one three sides" (a bay) and another might say, "This body of water is where ships are kept safe from the ocean" (a harbor).

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

1.S.1A.1 Ask and answer questions about the natural world using explorations, observations, or structured investigations.

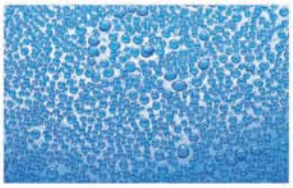
1.E.4A.1 (b) Use observational data to sort the Earth's materials (e.g., rocks, soils, sand, water) based on physical properties.

- Students will make observations about various materials and then use those observations to sort additional materials.
- Gather the following materials: rocks, sand, soil, and water.
- Allow students sufficient time to interact with each material. As a class, complete the following chart with observations of each material. Ask the students, "What do these look like?" and "How do they feel?" to gather their observations. Your class chart may look like this:

Materials	What does it look like?	How does it feel?
Rocks	*Many colors, big and small*	*Hard*
Sand	*Light brown and small*	*Soft or grainy*
Soil	*Dark brown, black, or loose*	*Crumbly, soft, damp*
Water	*Clear*	*Wet*

- After students have made their observations, they will use them to sort materials.
- Create a sorting chart with columns for "Rocks," "Sand," "Soil," and "Water."
- Then, provide a collection of images such as boulders, water drops, pebbles, ocean water, beach sand, dirt, gravel, desert sand, etc.

- Review your observations of the materials and together sort the images onto the chart. Your chart may look like this:

Rocks	Sand	Soil	Water
			

First Grade

Core Concept: Life Science: Plants and Their Environment

It is essential for students to know: A plant is composed of different structures, each of which enables the plant to survive, grow and produce more plants (1.L.5A.1). Plants have life cycles with distinct stages (1.L.5A.2). Water and light are the basic things plants need to survive (1.L.5B.1). Different environments or surroundings of living things (e.g., air, water, soil, plants, and animals) support different types of plants. Plants have different characteristics that help them survive in distinct environments (1.L.5B.2). Each type of plant has a different environment in which it can survive and thrive. Changes in environment can happen slowly or quickly and impact the way a plant responds in the environment (1.L.5B.3).

Most Complex ←		→ **Least Complex**
1.L.5A.1 (a) Use models and data to explain how different plant structures (e.g., roots, stems, leaves, flowers, fruits, seeds) help plants survive, grow and produce more plants.	1.L.5A.1 (b) Match different plant structures (e.g., roots, stems, leaves, flowers, fruits, seeds) to their function (e.g., roots hold plant in place).	1.L.5A.1 (c) Identify different plant structures (e.g., roots, stems, leaves, flowers, fruits, seeds).
1.L.5A.2 (a) Use models to describe the stages of the life cycle of a flowering plant as it grows from seed.	1.L.5A.2 (b) Use models to order the stages of the life cycle of a flowering plant (e.g., begins to sprout, grows, flowers, makes seeds).	1.L.5A.2 (c) Identify the life cycle of a flowering plant as it grows from seed to plant.
1.L.5B.1 (a) Explain why plants need air, water, sunlight, minerals, and space to live and grow.	1.L.5B.1 (b) Investigate to describe what plants need to live and grow (e.g., air, water, sunlight, minerals, and space).	1.L.5B.1 (c) Identify basic plant needs (e.g., air, water, sunlight, soil, space).
1.L.5B.2 (a) Use models to compare how different characteristics of plants help them survive in distinct environments (e.g., deserts, forests, grasslands).	1.L.5B.2 (b) Identify characteristics of plants that live in distinct environments (e.g., cactus stores water).	1.L.5B.2 (c) Match a plant to its distinct environment (e.g., cactus to desert).
1.L.5B.3 (a) Use observations to describe how environmental changes cause plants to respond in different ways (e.g., leaves turning toward the sun; in autumn, leaves changing colors).	1.L.5B.3 (b) Identify an environmental change that causes a plant to respond (e.g., when it is too hot, a plant wilts; in winter, some trees shed leaves).	1.L.5B.3 (c) Match a change in an environment to a response in a plant (e.g., leaves changing colors).

Application of Performance Indicators at the Middle Level—Instructional Activities

1.L.5A.2 (b) Use models to order the stages of the life cycle of a flowering plant (e.g., begins to sprout, grows, flowers, makes seeds).

- The objective of this lesson is teach students about the life cycle of a plant. Note: this will be a long-term lesson due to the need for students to observe the life cycle of a flowering plant.
- Introduce the lesson by reading the book *The Tiny Seed* by Eric Carle.
- Explain that a plant goes through different stages as it grows. Describe the stages: sprouting, seedling, mature plant, and flowering. Explain what happens at each stage by creating an anchor chart with the students:
  - At the sprouting stage, the seed is underground with roots starting to emerge.
  - At the seedling stage, the roots grow farther down into the ground and a stem emerges.
  - At the mature plant stage, the roots are larger, the stem is taller, and leaves develop.
  - At the flowering stage, the plant matures and flowers begin to grow from the plant.
- Provide students with a piece of construction paper folded into fourths, each box representing a stage in the plant life cycle.
- Have students label the chart using the words or picture symbols for the each stage of the plant lifecycle ("Sprouting," "Seedling," "Mature Plant," "Flowering").
- Plant a seed or several seeds in cups. At each stage of the plant life cycle, have students observe the plant. Allow them to draw, write, or paste picture symbols in the correct section of the life cycle chart based on their observations. Discuss what they see at each stage of development. What is happening? What is the next stage of the life cycle?

Activity adaptation for less complexity

1.L.5A.2 (c) Identify the life cycle of a flowering plant as it grows from seed to plant.

- For students who may need additional support, simplify the lesson by showing students how a plant goes a different stages of a life cycle as it grows.
- Introduce the lesson by reading the book *The Tiny Seed* by Eric Carle.
- Collect different samples that show the different stages of the plant life cycle (e.g., seeds, sprout, seedling, mature plant, flowering plant). Providing students with real examples may be more beneficial than relying only on pictures.
- Allow students to observe and touch each example. Encourage students to hold the seeds, examine a small pot with a sprout or a seedling, and smell a mature plant and flowering plant.
- As students are examining the samples, explain that there are stages a plant goes through as it grows. Describe the stages (sprouting, seedling, mature plant, flowering). Explain what happens at each stage by creating an anchor chart with the students:
  - At the sprouting stage, the seed is underground with roots starting to emerge.
  - At the seedling stage, the roots grow farther down into the ground and a stem emerges.
  - At the mature plant stage, the roots are larger, the stem is taller, and leaves develop.
  - At the flowering stage, the plant matures and flowers begin to grow from the plant.

Activity adaptation for more complexity

1.L.5A.2 (a) Use models to describe the stages of the life cycle of a flowering plant as it grows from seed.

- For students who have the skills to go further, have them grow a seed to recreate a plant life cycle.
- Introduce the lesson by reading the book *The Tiny Seed* by Eric Carle.
- Explain that there are stages a plant goes through as it grows. Describe the stages: sprouting, seedling, mature plant, and flowering. Explain what happens at each stage by creating an anchor chart with the students:
  - At the sprouting stage, the seed is underground with roots starting to emerge.
  - At the seedling stage, the roots grow farther down into the ground and a stem emerges.
  - At the mature plant stage, the roots are larger, the stem is taller, and leaves develop.
  - At the flowering stage, the plant matures and flowers begin to grow from the plant.
- To grow seeds, you will need the following materials:
  - A few seeds for each student (e.g., lima beans)
  - Paper towel
  - Stapler
  - Zippered sandwich bag
  - Water
  - Permanent marker
- First, label each bag with the student's name and the date.
- Wet a paper towel and put the seeds in the center. Fold the paper towel so that it fits inside the bag.
- Push out any air in the bag and seal it. Place the bags in a sunny area (e.g., tape to a window, place on a window sill). Open the bag every day to allow air to circulate. Add some water if necessary to keep the paper towel moist, but do not soak it. This may cause the beans to rot. Seal the bag at the end of each day.
- Within a few days, the seeds will begin to germinate. Students will see the growth of roots and then the sprouts. As soon as the young plants reach the top of the sealed bag, they can be carefully removed and potted in soil. Continue to observe the development of the plant life cycle in its new environment.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

1.S.1A.3 With teacher guidance, conduct structured investigations to answer scientific questions, test predictions and develop explanations: (1) predict possible outcomes, (2) identify materials and follow procedures, (3) 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.

1.L.5B.1 (b) Investigate to describe what plants need to live and grow (e.g., air, water, sunlight, minerals, and space).

- The goal of the investigation is for students to determine the type of soil a plant needs.
- Materials:
  - Two small plants of the same type (e.g., geraniums, tomatoes)
  - Two small pots
  - Potting soil
  - Sand
  - Water
- Begin by discussing what plants need to live: air, water, sunlight, soil, and space to grow. Explain that we do not always know the specific needs of different types of plants. One way to find out is to do an investigation. Tell students that we are going to put one plant in soil and the other plant in sand. The only variable that is different is what the plants are potted in (soil or sand). This investigation will tell us how this one variable determines what a plant needs to live and grow.
- Pot one plant in soil and the other in sand, and place the plants in a sunny location. Have students observe the plants every day. Add the same amount of water to each plant every other day.
- After two weeks, discuss what happened to each plant. The plant in soil will have survived and grown, while the plant in sand would have withered or died. Why did this happen? What is our conclusion about this type of plant? Does it need soil or sand to live?

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Age 7 on or before September 1 (Grade 2)

Second Grade

Core Concept: Earth Science: Weather

It is essential for students to know: There are different types of weather conditions, which can be described using weather terminology such as temperature, wind direction, wind speed, and precipitation (2.E.2A.1). Weather conditions can sometimes be severe, such as floods, lightning storms, tornadoes, thunderstorms, and hurricanes (2.E.2A.4). When air in the form of wind interacts with objects, it causes the objects to move (2.E.2A.3). There are four basic seasons, each of which has a distinct weather pattern (2.E.2A.2).

Most Complex ←		→ **Least Complex**
2.E.2A.1 (a) Use data from observations and measurements to describe local weather conditions (e.g., temperature, wind speed, and forms of precipitation).	2.E.2A.1 (b) Make connections between weather conditions (e.g., cold, windy, rainy) and observable data (e.g., temperature, leaves blowing, rain gauge).	2.E.2A.1 (c) Use pictures to identify local weather conditions, including temperature and precipitation.
2.E.2A.2 (a) Use local weather data and observations to predict daily and seasonal patterns over time.	2.E.2A.2 (b) Use pictures and data to describe types of daily and seasonal weather changes.	2.E.2A.2 (c) Use pictures to identify daily and seasonal weather.
2.E.2A.3 (a) Use models to describe and compare the effects of wind on objects (e.g., turning on a fan at low, medium, and high).	2.E.2A.3 (b) Use illustrations to identify objects moved or not moved by wind (e.g., kite in air or on ground).	2.E.2A.3 (c) Use pictures to identify object moved by wind (e.g., flag waving, kite in air). Identify wind as moving air.
2.E.2A.4 (a) Create models to identify appropriate safety precautions for severe weather conditions.	2.E.2A.4 (b) Identify safety precautions for severe weather.	2.E.2A.4 (c) Identify the severe weather conditions.

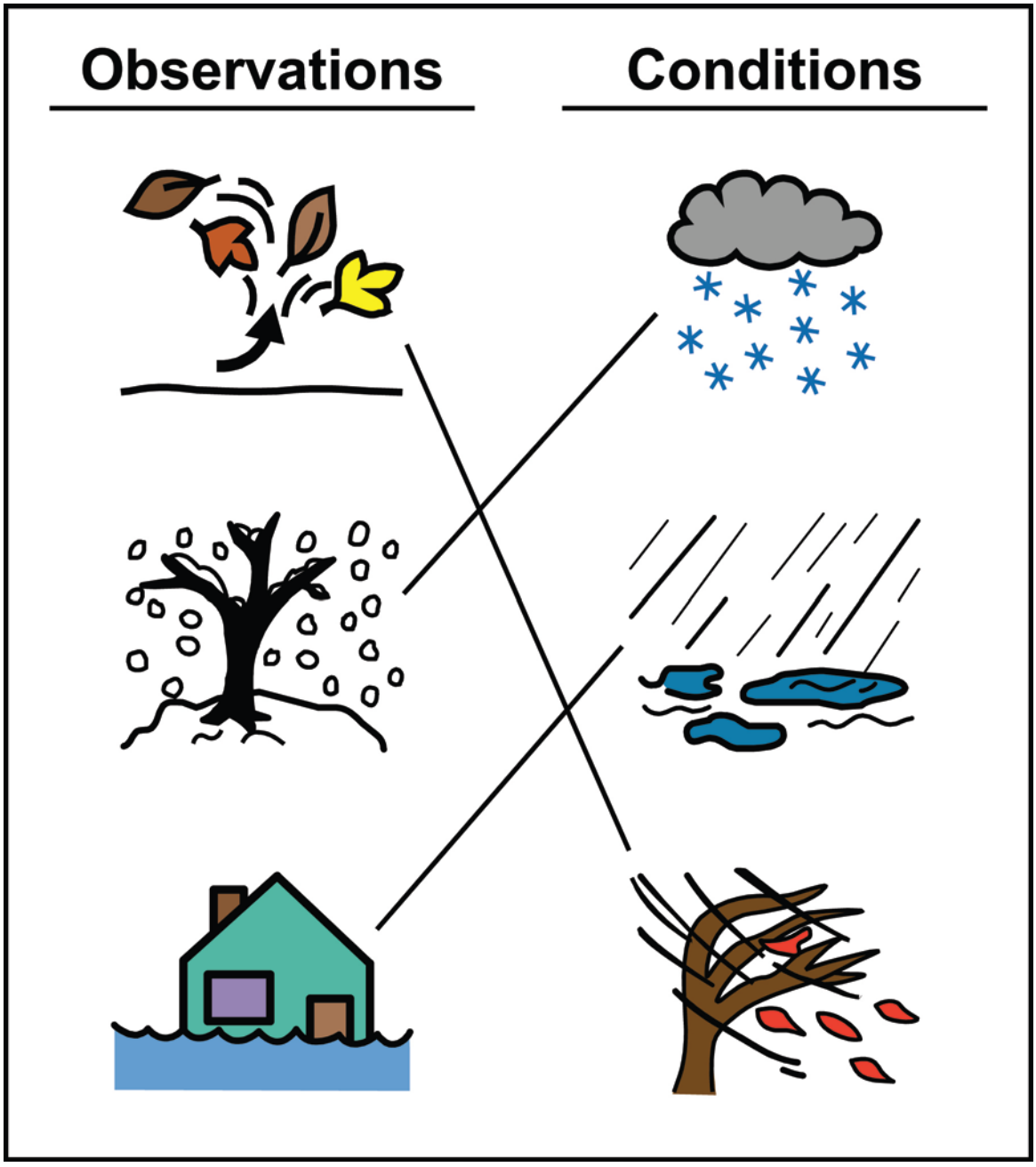
<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

2.E.2A.1 (b) Identify safety precautions for severe weather.

- The goal of this lesson is to make an observation about weather and match it with its weather condition.
- Create a two-column chart, without the vertical line separating the columns. Label the left column "Observations" and the right column "Conditions." Pre-fill the "Observations" column with picture symbols of something a student might see or do during a weather event (e.g., leaves blowing, river flooding, snow falling). Pre-fill the "Conditions" column with picture symbols of

different weather conditions (e.g., windy, rainy, snowy). Make sure that the pictures in the "Conditions" column are not adjacent to the correct answer in the "Observations" column.

- Model the activity. For example, if the first picture in the "Observations" column shows leaves blowing, you might say, "I see a picture of leaves blowing. That means the weather is windy." Draw a line from the picture symbol on the left to its corresponding weather condition on the right (in this case, it would be windy). Give each student an opportunity to draw a line matching an observation to a weather condition. A sample chart is shown:



- The activity may also be simplified by having students match the pairs and glue them next to each other on the chart.

Activity adaptation for less complexity

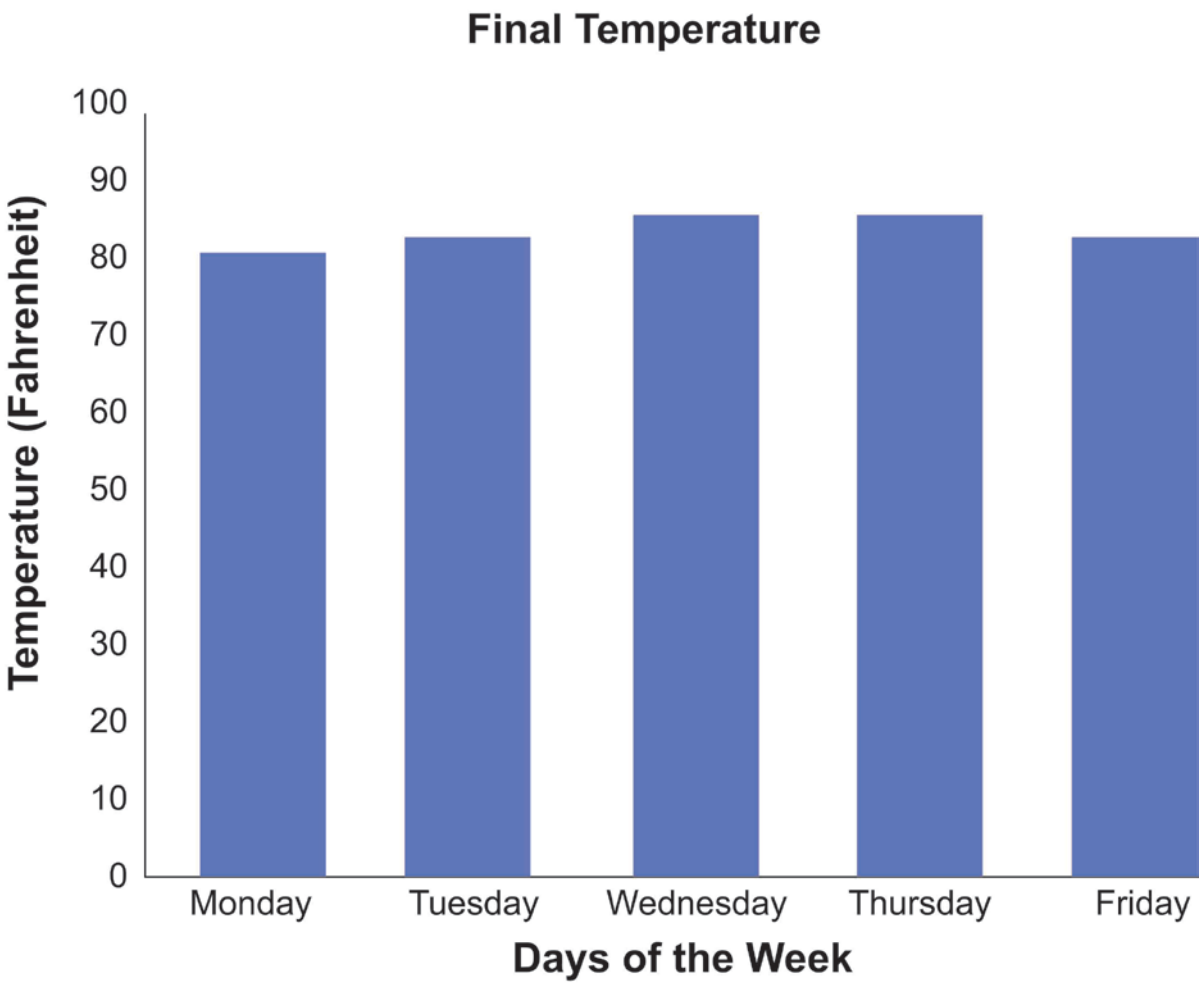
2.E.2A.1 (c) Identify the severe weather conditions.

- For students who may require more support, provide pictures of different weather conditions with observable visual cues that suggest the type of weather (e.g., leaves blowing, people dressed in rain boots, a cloudy sky).
- Ask students to identify the different types of conditions.
- Provide sensory input to support students' understanding. For example, you could use a small, hand-held fan to help them understand windy conditions; allow students to dip their fingers into a cup of water to help them understand rainy conditions; or have students touch a bag filled with ice to understand the concept of cold.

Activity adaptation for more complexity

2.E.2A.1 (a) Use data from observations and measurements to describe local weather conditions (e.g., temperature, wind speed, and forms of precipitation).

- Have students observe and record the local weather each day. Provide students with a fill-in the blank chart to assist them in their description of weather conditions.
  - What is the temperature today?
  - Is the wind blowing today?
  - Is it raining?
  - Is it snowing?
  - It feels _____ outside today.
  - I need to wear _____ when I am outside today.
- Ask each student to give a local weather report using his or her observation sheet. You could extend students' learning by having them create a bar graph showing the number of days a certain weather condition occurred during a period of time, such as a week or a month. The bar graph might end up looking like this:



<u>Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities</u>

2.S.1A.4 Analyze and interpret data from observations, measurements, or investigations to understand patterns and meanings.

2.E.2A.2 (a) Use local weather data and observations to predict daily and seasonal patterns over time.

- The goal of this investigation is to have students observe and predict local weather patterns.
- Collect a copy of a local or national newspaper and display the weather section. Read aloud the weather report. Point out the different features associated with this section (e.g., maps, daily or weekly forecast, pictures, temperatures, precipitation, weather trends). Focus student attention on the weekly forecast and describe it.
- Ask students to share what they observe. Talk about the temperature. Does it change from day to day? On what day is it warmest or coldest? Based on the weather, ask students to predict the weather for the next day and the upcoming week. Are there any weather patterns? How should we prepare for the weather next week? What would be appropriate clothes to wear?

Second Grade

Core Concept: Physical Science: Properties of Solids and Liquids

It is essential for students to know: Matter can be described based on observed and measured properties of solids and liquids (2.P.3A.1). Two types of matter can be mixed together to create mixtures (2.P.3A.2). When heat is added or removed, solids and liquids can change states (2.P.3A.3). Magnets have poles at each end which attract or repel each other (2.P.3B.1). Magnets are attracted to some objects based on the object's properties (2.P.3B.2). Magnets can be useful in everyday life (2.P.3B.3).

Most Complex ←		→ **Least Complex**
2.P.3A.1 (a) Describe solids and liquids.	2.P.3A.1 (b) Sort matter as solid or liquid.	2.P.3A.1 (c) Identify matter as a solid or liquid.
2.P.3A.2 (a) Use models to demonstrate how a mixture can be mixed together and then separated again based on the components of the mixture (e.g., pull out parts of a salad).	2.P.3A.2 (b) Use models or pictures to identify components of a mixture. (e.g., lettuce and tomato are parts of a salad).	2.P.3A.2 (c) Use models or pictures to identify a mixture (e.g., choose which one is a mixture: salad or tomato).
2.P.3A.3 (a) Predict changes to solids and liquids when heat is added or removed.	2.P.3A.3 (b) Use observations to identify whether heat was added or removed to create melting or freezing.	2.P.3A.3 (c) Identify whether a substance has been melted or frozen.
2.P.3B.1 (a) Identify which poles of a magnet attract or repel one another.	2.P.3B.1 (b) Use observations to identify the force (push–move away or pull–stay together) of same or opposite poles of a magnet.	2.P.3B.1 (c) Identify a magnet.
2.P.3B.2 (a) Compare the properties of objects that are and are not attracted by magnets.	2.P.3B.2 (b) Classify objects based on whether they are attracted or repelled by a magnet.	2.P.3B.2 (c) Identify whether an object is attracted to a magnet.
2.P.3B.3 (a) Describe how magnets can help people (e.g., by holding things to the front of a refrigerator or holding a cabinet door shut)	2.P.3B.3 (b) Identify how a magnet can be used.	2.P.3B.3 (c) Identify a magnet in use (e.g., holding cabinet doors closed or open, holding up notes).

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

2.P.3B.2 (b) Classify objects based on whether they are attracted or repelled by a magnet.

- The goal of this lesson is for students to identify objects that are attracted or repelled by a magnet.

- Collect different types of magnets (e.g., refrigerator magnets, paperclip holder, bar magnet) and various items that will attract or repel magnets (e.g., key, paper clips, paper towel, plastic, glass, eraser, coins).

- Introduce the terms attract and repel. Explain to students that magnetism is a force that can move objects. This is done by either attracting or repelling an item.
- Have students share with their peers or demonstrate ways they use magnets (e.g., hanging objects on their home refrigerator, closing a cabinet door, opening and closing a bag or purse with a magnet). If needed, sharing with peers can be achieved through the use of pre-programmed switches.
- Students will take turns manipulating and investigating materials provided in a whole-group setting. Demonstrate for the students how objects will either move toward (attract) or move away (repel) from a magnet when a magnetic force is applied. Select an item and make a prediction whether the item will be attracted or repelled by a magnet. Engage in "think aloud" strategy to model for students how you used the characteristics of the item to make your prediction. Test your prediction by moving the object close to the magnet. State the results of your experiment. If you are testing the magnetism of a plastic bottle, for example, you might say, "The magnet has no effect on the plastic bottle because the objects did not move toward each other."
- Ask students to select an object from the classroom and predict whether or not their magnet will attract or repel the item. Have each student test their prediction by moving their object close to the magnet to see if it is attracted to or repelled.

<u>Activity adaptation for less complexity</u>

2.P.3B.2 (c) Identify whether an object is attracted to a magnet.

- Simplify the lesson for students who require additional support by focusing only on the term attract. Explain that magnetism is a force that can move objects toward each other. This is called attraction. When objects move toward the magnet, they are attracted to its magnetic field. Sometimes you can feel the pull of the magnet to the object. Demonstrate this using a magnet, such as a bar magnet, and paper clip. For maximum effect, place the magnet and the paper clip on a flat surface so students can see the attraction occurring between the objects.
- Repeat this process with student involvement. Allow each student to select an object (e.g., key, paper clips, paper towel, plastic, glass, eraser, coins). Have each student place his or her object on the flat surface and slowly move it toward the magnet. Ask students to indicate whether their item is attracted to the magnet. You might say, "Is your object attracted to the magnet? How do you know? What did you see? How did the attraction feel?"
- For students with visual impairments, they can participate by feeling the magnet and object as the force is being applied.

<u>Activity adaptation for more complexity</u>

2.P.3B.2 (a) Compare the properties of objects that are and are not attracted by magnets.

- For students who have the skills to go further, additional steps can be added to the previous activity. Prior to beginning, have students predict whether or not the items in the container will attract or repel the magnet (students should be provided a chart to record their predications or

data—include a yes/no category next to their predictions so they can confirm their predictions at the end).

- After they have made all their predictions, have them go back through the list of objects and test each one to see if it is attracted to or repelled by the magnet. Have students mark yes or no next to their predictions.
- Discuss with the students the similarities and differences between the two groups. Ask probing questions to get the discussion started. "Do you notice any similarities between the objects that are attracted?" and "Are there any similarities between the objects that are not attracted by the magnet?" Students should conclude that most of the metal objects are attracted to the magnet and the nonmetal objects are not being attracted.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

2.S.1A.3 With teacher guidance, conduct structured investigations to answer scientific questions, test predictions and develop explanations: (1) predict possible outcomes, (2) identify materials and follow procedures, (3) 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.

2.P.3B.3 (a) Describe how magnets can help people.

- Investigate the strength of magnets and how they help people.
- Materials:
  - Three or four different magnets with varying shapes, size, and weight (e.g., refrigerator magnets, paperclip holder, bar magnet)
  - Box of paper clips
  - Chart paper
  - Science Journal
- Explain the purpose of the investigation. Students will determine the strength of different magnets.
- Present students with the different magnets. Allow them to touch and hold the magnets to help familiarize them with the magnets' different shapes, sizes, and weights.
- Ask students to predict which magnet they think has the strongest force. You might say, "Which is the largest magnet? Which is the smallest? Which is the heaviest magnet? Which is the lightest?"
- Have students write their prediction in their Science Journals. If students do not initiate a prediction independently, guide them to make a prediction. For example, you may have them glue in their notebooks a sentence strip that states, "I think the largest/biggest magnet will hold _____ paper clips." Provide students with picture symbols for the most and the least so they can record their prediction. Student may also draw the magnet of choice.
- Procedure:
  - Begin by choosing only one magnet. Start placing paper clips one at a time on the end of the magnet (creating a chain of paper clips) until the paper clips will not "stick" to the chain.

- Have students observe and record the results in their Science Journals (They should note the type of magnet and number of paper clips the magnet holds). Student can record their findings by creating a pictogram or bar graph.
- Repeat steps 1 and 2 with the other magnets.
- Discuss whether or not their predictions were correct. “Does the size of the magnet match its strength? How does the strength of a magnet impact how it is used?”

Second Grade

Core Concept: Physical Science: Exploring Pushes and Pulls

It is essential for students to know: Both the strength of push or pull and the direction of the push or pull can affect the motion of an object. Pushes and pulls can make the object move faster, or slower, stop an object or make it change directions (2.P.4A.1). When an object is pushed or pulled, it can create friction. Friction is a pull that acts against motion. Friction is greater on rough surfaces than smooth ones (2.P.4A.4). The pull of the Earth's gravity causes objects to fall towards the Earth (2.P.4A.3).

Most Complex ⟵		⟶ **Least Complex**
2.P.4A.1 (a) Predict and compare the effects of different strengths and directions of pushing and pulling on the motion (e.g., moved least or most, changed direction) of an object.	2.P.4A.1 (b) Identify the effects of different strengths and directions of pushing and pulling on the motion of an object (e.g., harder push moves an object farther).	2.P.4A.1 (c) Identify examples of push and pull.
2.P.4A.3 (a) Investigate to predict and compare what will happen (e.g., gravity pulls) when an object is released.	2.P.4A.3 (b) Use models to demonstrate what will happen when an object is released.	2.P.4A.3 (c) Recognize that an object will fall when released.
2.P.4A.4 (a) Predict and compare the impact that friction has motion (e.g., does the car move further on carpet or tile?).	2.P.4A.4 (b) Identify the impact of varying amounts of friction on the motion of an object (e.g., which one went further?).	2.P.4A.4 (c) Identify a surface as smooth or rough.

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

2.P.4A.1 (b) Identify the effects of different strengths and directions of pushing and pulling on the motion of an object (e.g., harder push moves an object farther).

- The purpose of this lesson is for students to identify the effects of using different strengths and directions when pushing and pulling items.
- Create a T-chart labeled "Force" and "Motion."
  - Pre-fill the "Force" section of the chart with possible examples from the book below (e.g., hard push, soft push, throwing, rolling, blowing, swinging).
- Begin the lesson by discussing how we can push and pull objects. When we want to sit at a table we have to pull out a chair. When we want to leave the table we have to push back the chair. We also do this by pulling open drawers and pushing them shut.
- Read the book *Give It a Push! Give It a Pull! A Look at Forces*, by Jennifer Boothroyd. While reading the book, pause occasionally and ask students to identify the effects of using different strengths and directions when pushing and pulling items. You might ask, "What happens when the force is stronger? How do objects change direction? How is this different when the force is weaker?"
- Fill in the "Motion" section of the chart with student responses. You can create picture symbol responses or sentence strips and allow the students to record their response on the chart.

Activity adaptation for less complexity

2.P.4A.1 (c) Identify examples of push and pull.

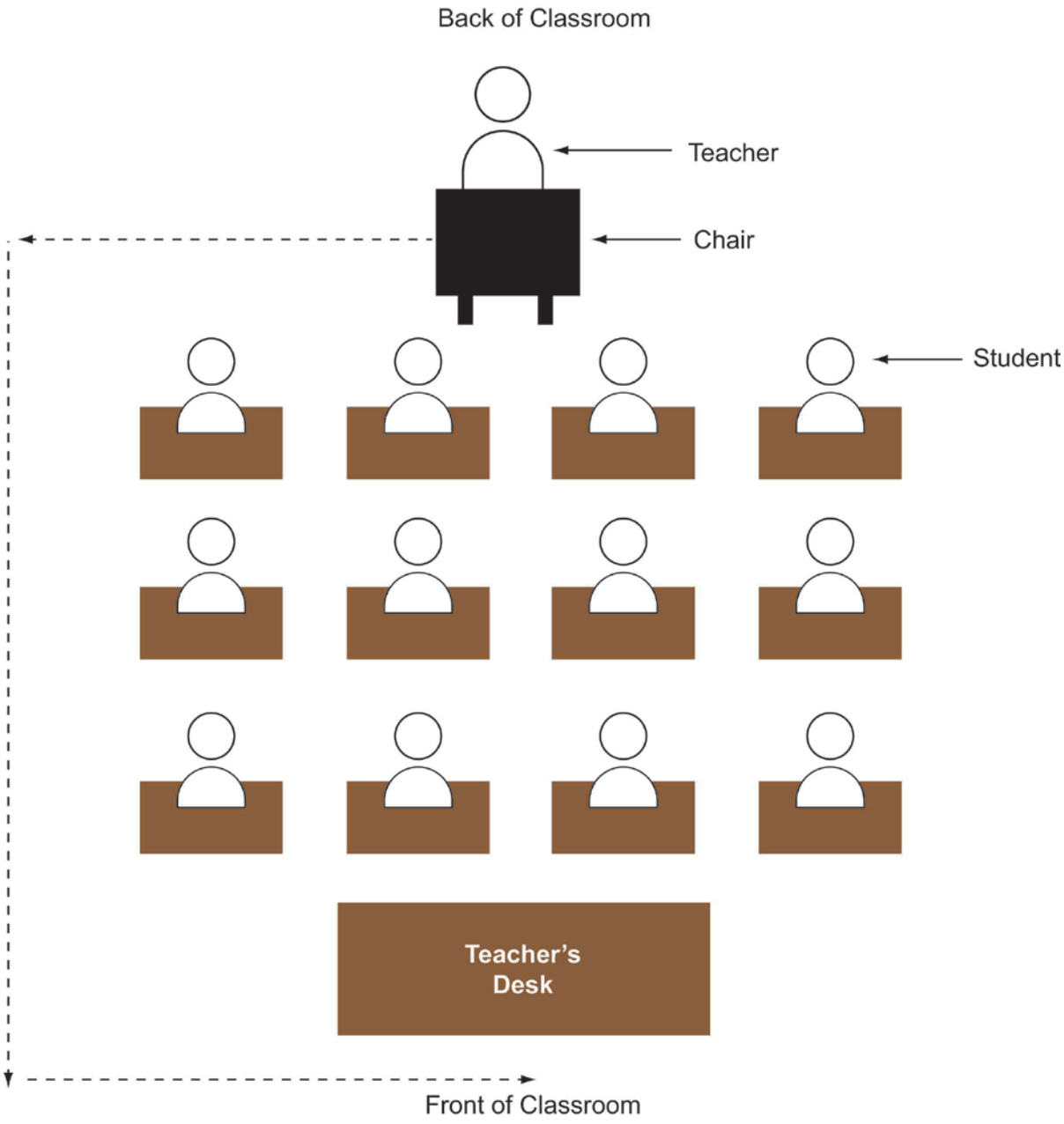
- For students who require additional support, simplify the previous lesson above by asking them only to identify examples of pushing and pulling from the book.
- Model what the actions pushing and pulling could look like (e.g., hold their hands up and push them away or outward or make two fists and pull arms into their chest) indicating pushing and pulling.
- While reading aloud, ask students to act-out the actions when they are presented.
- Assist students by modeling the actions while reading.

Activity adaptation for more complexity

2.P.4A.1 (a) Predict and compare the effects of different strengths and directions of pushing and pulling on the motion (e.g., moved least or most, changed direction) of an object.

- After reading about what happens to objects when different forces are applied to them, students will give instructions to the teacher to push or pull an object to move it to a specific location.
- Prior to reading a book, have a chair at the back of the classroom with a clear path to the teacher's desk.
- Read the book, *Give It a Push! Give It a Pull! A Look at Forces* by Jennifer Boothroyd.

- After reading the book, explain to students that they are going to apply their knowledge of forces to give the teacher directions. The goal is to have the teacher push or pull the chair in different directions until the chair is behind the teacher's desk where it belongs. A sample diagram is shown below:



- Some questions to help lead the students might include:
  - "On which side of the chair should I stand?"
  - "Now, should I push the chair or pull the chair?"
  - If the teacher finds him/herself against the wall, say, "I cannot move any farther. On which side of the chair should I stand?"

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

2.S.1A.3 With teacher guidance, conduct structured investigations to answer scientific questions, test predictions and develop explanations: (1) predict possible outcomes, (2) identify materials and follow procedures, (3) 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.

2.P.4A.4 (b) Identify the impact of varying amounts of friction on the motion of an object (e.g., which one went further?).

- Students will investigate how far a toy car will move across different types of surfaces.
- Materials:
  - Toy car
  - Smooth surface
  - Rough surface
  - A portable ramp
  - Measuring tape
  - Masking tape
  - Timer
  - Science Journal
- Discuss what friction is with students. Friction is a force that slows things down. There is friction on a toy car (wheels) and the surface it travels on. The amount of friction will depend upon the nature of the two surfaces.
- Together, observe the smooth and rough surfaces. Which surface would cause more friction with the wheels of the toy car? (Rough.) Have students write a complete sentence prompt (e.g., "I think the toy car will go farther on the _____ surface."), or paste picture symbols for smooth and rough in their Science Journals to record their predictions.
- Procedure:
  - Locate a smooth surface with plenty of open room (in the classroom or on the playground).
  - Release the toy car from the top of the ramp and allow it to come to a stop on the surface.
  - Have a student helper place the masking tape where the car stopped.
  - Measure the distance from the bottom of the ramp to the masking tape.
  - Students should record the distance in their Science Journals.
  - Repeat this procedure on a rough surface.
- Review the results and discuss how friction impacted the distance the car traveled. Were their predictions correct? Why? Why not?

Second Grade

Core Concept: Life Science: Animals and Their Environment

It is essential for students to know: Animals can be classified based on their physical characteristics, such as their methods of mobility, obtaining food, and production of young (2.L.5A.1). Animals have special body parts they use to survive (2.L.5A.2). All animals go through a life cycle (2.L.5A.3). Animals require air, food and water and can only survive in environments where their needs can be met (2.L.5B.2). Animals respond to changes in their environment in different ways, such as hibernation and migration (2.L.5B.3). Animals can change the environment in which they live; these changes can be both harmful and helpful (2.L.5B.4).

Most Complex ←		→ **Least Complex**
2.L.5A.1 (a) Classify animals (e.g., mammals, birds, reptiles, fish, or insects) based on their physical characteristics.	2.L.5A.1 (b) Identify a physical characteristic of animals (e.g., fur, fins, scales).	2.L.5A.1 (c) Match animals by their physical characteristics.
2.L.5A.2 (a) Explain how structures (e.g., for seeing, hearing, grasping, protection, locomotion and obtaining and using resources) of different animals help them survive.	2.L.5A.2 (b) Match the body part to its function (e.g., mouth for eating).	2.L.5A.2 (c) Identify the body part of an animal.
2.L.5A.3 (a) Use observations of an animal as it grows and changes to describe the stages of its development.	2.L.5A.3 (b) Sequence the stages of a life cycle.	2.L.5A.3 (c) Recognize the stages of an animal's life cycle, (e.g., baby, adolescent, adult).
2.L.5B.2 (a) Identify traits that help organisms survive in distinct environments (webbed feet on ducks and frogs help them survive in watery environments).	2.L.5B.2 (b) Identify characteristics of animals that help them survive in distinct environments (e.g., water, desert, forest, polar). Identify how a characteristic helps an organism (webbed feet help a duck swim).	2.L.5B.2 (c) Match an animal to its environment based on a characteristic. Identify a unique characteristic of an organism (a duck has webbed feet).
2.L.5B.3 (a) Describe how animals respond to changes in their environment (e.g., food availability, water, weather conditions).	2.L.5B.3 (b) Match an animal's response to a change in the environment.	2.L.5B.3 (c) Identify changes that can occur in an environment (ex., food availability).
2.L.5B.4 (a) Describe how humans can be helpful or harmful to an environment.	2.L.5B.4 (b) Identify how humans have changed the environment (e.g., cut down trees, grow a field of crops).	2.L.5B.4 (c) Observe a way humans have changed land (e.g., cut down trees, grow a field of crops, build a city).

Application of Performance Indicators at the Middle Level—Instructional Activities

2.L.5B.2 (b) Identify characteristics of animals that help them survive in distinct environments (e.g., water, desert, forest, polar). Identify how a characteristic helps an organism (webbed feet help a duck swim).

- The purpose of this lesson is for students to identify the characteristics of animals that help them survive in distinct environments.
- Begin the lesson by discussing adaptations. Adaptations are special skills or traits that animals have to help them survive in their environment. For example, the Arctic fox has thick white fur. The fur protects it from extreme cold temperatures and allows it to camouflage easily in the snow. During warmer months, the Arctic fox's fur changes to brown or gray. This helps the Arctic fox hunt birds and fish without being detected.
- You will lead the students through a lesson in which they identify adaptations of animals in one environment. Create a T-chart. Label the left column "Animal" and place labeled picture symbols of animals found in one environment (e.g., water, desert, forest). Label the right column "Adaptation." Here, students will place a picture symbol for the animal's adaptation in the selected environment. Choose at least one animal per student so each has a turn to identify an animal's adaptive trait. For example, you may decide to work on adaptations of animals in the desert. Some animals you discuss may include a camel, a fox, a fat sand rat, a desert lark, and a rattlesnake. Your chart may look something like this:

Animal	Adaptation
• camel	• Large footpads
• fox	• Large ears
• fat sand rat	• Thick layer of body fat
• desert lark	• Feathers match the color of desert soil
• rattlesnake	• Forked tongue used to hunt food

- After completing the chart, you might extend students' understanding by asking them the purpose of each adaptation. How are large footpads useful to a camel in sandy terrain? (The wideness of the footpads keeps their feet from sinking too far into the sand while they walk) Why would the fox benefit from having large ears in a hot environment? (Their large ears release heat in the hot environment) How would a fat sand rat use body fat when food is scarce? (The rat's body will use its body fat as a source of energy when they cannot get energy from food) Why would a desert lark want to blend in with its surroundings? (To help it hide from predators) How does a forked tongue help a rattlesnake hunt food? (There forked tongues sense odors in their surroundings)

Activity adaptation for less complexity

2.L.5B.2 (c) Match an animal to its environment based on a characteristic. Identify a unique characteristic of an organism (a duck has webbed feet).

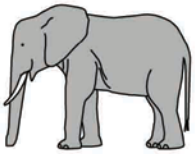
- For students who require additional support, simplify the lesson by having them match an animal to its environment based on a characteristic of that animal.
- Begin the lesson by discussing adaptations. Adaptations are physical traits that animals have to help them to survive in their environment. These traits can be related to how the animal regulates its body temperature, how it moves, or how it stores food. For example, a duck has webbed feet, which allow it to swim easily on the surface of water. Some species of hummingbirds have long, thin bills that allow them to reach deep into flowers to drink nectar.
- In this lesson, you will work with animals in various environments. Create a T-chart. Label the left column "Animal" and the right column "Environment." In the left column, pre-place picture symbols or photographs of animals found in different environments. These should be animals familiar to students (e.g., monkey, fish, fox, lizard, giraffe). In the "Environment" column, have students place a picture symbol or photograph of the environment in which that animal can be found. There should be only one animal per environment, and vice versa. Some suggestions for environments include rainforest, ocean, woods, desert, or grassland.
- To extend the activity, ask students what other animals live in the environment they identified.

Activity adaptation for more complexity

2.L.5B.2 (a) Identify traits that help organisms survive in distinct environments (webbed feet on ducks and frogs help survive in watery environments).

- For students with the skills to go further, have them identify specific traits that allow animals to survive in distinct environments. Discuss how animals in a particular environment may have similar traits that make them well-adapted to living in that environment.
- In this lesson, you will work with animals in various environments. Create a table with three columns. Label the left column "Environment"; the middle column "Animals"; and the right column "Traits." In the "Environment" column, pre-place picture symbols or photographs of different environments (e.g., grassland, ocean, freshwater, forest, desert). You might want to discuss the environment (e.g., "What environment is this? Is it wet or dry? Hot or cold?"). This will help students begin making a connection between an animal's physical traits and its ability to survive in its environment. In the "Animals" column, have students take turns placing two or three animals that live in a particular environment. In the "Traits" column, ask students to think about the physical characteristics that the animals that they identified would need to survive in the

environment. Based on this discussion, have students place a picture symbol of the trait or a photograph of the animal with the physical characteristic circled in the “Traits” column.

Environment	Animals	Traits
grassland	giraffe	long neck
	 elephant	long trunk
ocean	turtle	flippers
	shark	fins

- Provide students with probing questions to think about while they complete this table:
  - How does this animal survive in its environment?
  - How does this animal breathe?
  - How does this animal stay warm? Cool?
  - How does this animal move from one place to another?
- Conclude by reviewing the table. Point out the environment, the type of animals found in that environment, and the traits needed in order to survive in the environment. You may choose to further the discussion by asking why animals in a particular environment do not have certain traits (e.g., "Why doesn't an elephant have gills? Why doesn't a fish have a trunk?").

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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

2.L.5A.3 (b) Sequence the stages of a life cycle.

- Students will create a model of a life cycle based on literature, and then observe the phenomena modeled by the life cycle.
- Materials:
  - A copy of The Very Hungry Caterpillar by Eric Carle
  - A poster of the butterfly life cycle picture symbol from board maker
  - A butterfly life cycle classroom kit
- Begin by reading *The Very Hungry Caterpillar*.
- Provide a poster with the board maker picture symbol for the butterfly life cycle. Ask the students, "How does the life of the butterfly begin?" Label the egg on the butterfly life cycle as "1." Then, ask the students to predict what happens next. Label the caterpillar as "2." Continue to sequence the chrysalis and butterfly as "3" and "4," respectively.
- Now that the model of the butterfly life cycle is complete, display the life cycle in the classroom. Explain to the students that they are going to observe this life cycle and check off each stage as they observe them.
- Set up a butterfly kit. Note that some butterfly life cycle kits start with the live caterpillar and not the egg.
- Observe the stage of the butterfly. If the kit arrives as an egg, place a check mark next to the egg. If the kit arrives with live caterpillars, check off the egg, and explain to the students that the caterpillars have already hatched. Show students actual pictures for the egg stage before checking off the egg stage to help them make the connections. Then check off the caterpillar stage.
- Continue to observe the caterpillar as it forms its chrysalis and emerges as a butterfly—checking off each stage. It may take at least three weeks for the butterfly to emerge from the chrysalis.

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Age 8 on or before September 1 (Grade 3)

Third Grade

Core Concept: Physical Science: Properties and Changes in Matter

It is essential for students to know: Matter is anything that has mass and takes up space. Properties of matter are characteristics that can be used to describe matter. Properties can be observed or measured (3.P.2A.1). Matter can be classified as a solid, liquid, or gas (3.P.2A.2). Water and other substances can change from one state to another when heat is added or taken away (3.P.2A.3).

Most Complex ←		→ **Least Complex**
3.P.2A.1 (a) Use data from observations and measurements to compare the physical properties of matter (e.g., length, mass, temperature, volume of liquids).	3.P.2A.1 (b) Use observations to identify the physical properties of matter (e.g., length: longer/shorter; mass: light/heavy; temperature: hot/cold; volume: more/less space of liquids).	3.P.2A.1 (c) Identify an observable property of a matter (using senses).
3.P.2A.2 (a) Use observations and measurements to describe how matter can be classified as a solid, liquid, or gas.	3.P.2A.2 (b) Use observations to classify a matter as a solid, liquid, or gas.	3.P.2A.2 (c) Identify an object as being a solid, liquid, or gas.
3.P.2A.3 (a) Investigate to determine how changes in heat (e.g., an increase or decrease) change the form of matter from one state to another (e.g., melting, freezing, condensing, boiling, evaporating).	3.P.2A.3 (b) Illustrate changes in the form of matter from one state to another (e.g., solid to liquid, liquid to solid) due to melting or freezing.	3.P.2A.3 (c) Identify a change in the form of matter (e.g., solid to liquid, liquid to solid).

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

3.P.2A.2 (b) Use observations to classify a matter as a solid, liquid, or gas.

- Materials:
  - Objects in the classroom that can be used as examples for solids, liquids, and gases
  - Cup of water
  - T-chart on an interactive whiteboard or chart paper
- The purpose of this lesson is to familiarize students with different states of matter.
- Begin the lesson by discussing solids, liquids, and gases. A solid has its own shape and does not flow. A liquid does not have its own shape and flows easily. It takes the shape of its container. A gas also flows and does not have its own shape.
- Ask students to look around the room and locate items that may be considered a solid, liquid, or gas (e.g., desk, chair, pencil, water from the sink, drink on a desk, the air we breathe).
  - An Internet search can also yield fun songs for students to learn detailing solids, liquids, and gases.

- Next, demonstrate a simple exercise that students could use to test whether or not matter is a solid, liquid, or gas.
  - Using a cup of water, show students how they can use their index finger to test whether or not matter is a solid, liquid, or gas. While using their finger they need to ask two questions:
    - Can you put your finger through it?
    - Can you pour it?
- Create a T-chart to record students' observations as a class. Place a checkmark in the "Finger" column if you can put your finger through the water. Place a checkmark in the "Pour" column if you can pour the water. If you cannot do either, place an X in the appropriate column. If you get two X's, then it is a solid. If you get two checkmarks, then it is a liquid. If you get one checkmark and one X, then it is a gas.

	Finger	Pour
Solid	X	X
Liquid	✓	✓
Gas	✓	X

- Finally, show students how they can act out the way different states of matter behave. Demonstrate for students how to become a molecule of matter. First, have them wrap their arms around their legs tightly, as if forming a ball. Explain that they are acting like a solid. Next, have them take a step back and demonstrate how they can move freely. Explain that they are acting like a liquid. Finally have them move far apart, acting as though they are floating all over the classroom. Explain that they are acting like a gas.
- You may modify the activity to make it more accessible to students with limited mobility. Line up students' chairs side-by-side in two rows. Explain that they are "packed" in like the molecules of a solid. Next, stagger the students' chairs so they are sitting slightly more apart, but are still within arm's length of each other. Explain that they are acting like free-flowing molecules of a liquid. Last, move the students so they are sitting in different parts of the classroom and cannot touch other students. Explain that they are acting like the spread-out molecules of a gas that take up a lot of space.

<u>Activity adaptation for less complexity</u>

3.P.2A.2 (c) Identify an object as being a solid, liquid, or gas.

- Materials:
  - Objects in the classroom that can be used as examples for solids and liquids
  - Clear Cup (such as a Solo cup) filled with water
  - Small blocks
  - Uninflated balloon
  - Effervescent antacid tablet (such as Alka-Seltzer).

- For students who may require additional support, provide them with a variety of materials and ask them to identify whether each material is a solid or a liquid.
- Begin the lesson by discussing our five senses: sight, sound, smell, touch and taste. What can our senses help us learn about materials? (e.g., size, heavy, smelly, rough, smooth, flexible, soft, hard, colorful, loud, or quiet)?
- Select an assortment of materials to present to students (in this example, blocks and water). You will need to be able to pour the blocks and the water into their own cups.
- As materials are presented, ask students to identify the state of matter using their senses:
  - When you pour solid objects from one cup into another, does it sound like loud thuds, or does it sound like a splash? Solid objects make loud sounds when they hit other objects. Liquids sound like a splash. Demonstrate this by pouring cubes into a cup and pouring water into a different cup.
  - Look at cubes in the cup and look at the water in the cup. You can see that the water takes the shape of the cup, but the blocks keep their shape. Solid objects do not fill up every little space in a cup like liquid water does.
  - Finally, feel the blocks. Can you put your finger through the block? Feel the water. Can you put your finger through water? Solid objects prevent us from being able to stick our fingers through them, but liquids allow our fingers to pass through easily.
- Discuss what senses they used to identify the blocks as solids and the water as liquid.
- Fill another cup with water and add the antacid tablet. Cover the cup opening with the balloon.
- With the class, observe changes to the balloon (the balloon should inflate quickly). Use the inflated balloon to discuss the characteristics of a gas. For example, a gas takes the shape of its container, and the molecules in gases spread out and have a lot of energy.

Activity adaptation for more complexity

3.P.2A.2 (a) Use observations and measurements to describe how matter can be classified as a solid, liquid, or gas.

- Materials:
  - A small clear cup of water (such as a clear Solo cup)
  - Effervescent antacid tablet (such as Alka Seltzer)
  - Science Journals
- To extend this lesson, conduct an observational experiment.
- Begin the lesson by introducing solids, liquids, and gases. A solid has its own shape and does not flow. A liquid does not have its own shape and flows. It takes the shape of its container. A gas also flows and does not have its own shape.
- Provide students with a Science Journal, allowing them to take notes and document observations.
- Create a solid, liquid, and gas experiment.
- A small cup of water and one tablet is needed for this investigation. Students should also have their Science Journals in which to record observations.
- Ask students to write down the properties of the tablet (solid) and water (liquid).

- Ask students to predict what will happen to the tablet when it is dropped in the cup. Float? Sink? Dissolve? (The tablet should sink and dissolve.) Students can record the predictions using a manner of writing appropriate to them. Refer to the "Incorporating Student Writing into the SC-Alt Science Content." Section of the introduction for possible strategies.
- Then, have each student drop the tablet into the cup of water at the same time.
- Discuss what they see. What is happening to the tablet? (It is dissolving and producing bubbles) Ask them to describe the bubbles that are being created. Explain that this is a gas. Have them put their hand over the top of the cup so they feel the gas (Students should feel fizz). Have students then put their hand on the side of the cup to observe the temperature (The cup should be warm). Describe how this is similar to the bubbles from a can of soda pop when it is first opened.
- Have students confirm their prediction and draw what happened in their Science Journals or on their observation pages.

<u>Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities</u>

3.S.1A.4 Analyze and interpret data from observations, measurements, or investigations to understand patterns and meanings.

3.P.2A.3 (b) Illustrate changes in the form of matter from one state to another (e.g., solid to liquid, liquid to solid) due to melting or freezing.

- This investigation has two parts:
  - Part 1: Students will observe matter changing from one state to another and then back again.
  - Part 2: They will then use their observations to predict the behavior of different matter.
- Note on Investigation Duration: This lesson will take up to four days to complete. Prepared ice trays will shorten the duration of the lesson.
- Materials:
  - Three ice cube trays
  - Water
  - Milk
  - Juice
  - Freeze pops
  - Science Journals
  - Access to a freezer
- Part 1:
  - Begin by introducing solids and liquids. A solid has its own shape and does not flow. A liquid does not have its own shape and flows. It takes the shape of its container. Water is a very common type of matter that we can observe. Water can be a liquid, or it can be solid as ice.
  - Show the students liquid water placed into an ice cube tray. Ask students to identify and write down what state of matter the water is currently. Solid? Liquid? The water should be a liquid.

- Next, discuss the temperature in the room. Is it warm? Cold? Provide students with the degrees, if possible, and have them record this observation in their Science Journal.
- Then, explain to your students that you are going to place the tray into a freezer overnight (You could also have prepared ice trays ready and continue the lesson). Discuss the temperature of the freezer. Warm? Cold? The temperature should be cold. Provide students with the degrees, if possible.
- Discuss the difference in temperatures between the freezer and the room and have the students record this observation in their Science Journal.
- On the next day, show the students the tray of water. Ask students to identify and write down the water's state of matter. Explain that the liquid water froze when it was placed in an environment that is below the freezing point.
- Ask the students to predict what will happen if the ice is left out in the room (you could also place the ice trays outside or by a window sill with sun). They should be able to support their prediction by noting that the temperature of the room is above the freezing point (or higher than in the freezer).
- Allow the ice to stay out in the room until it is melted, and have the students confirm that their prediction is correct by observing that the ice has become liquid again.

- Part 2:
  - Now students should be able to apply their observations to predict the behavior of other matter.
  - Begin with an ice cube tray that has water, an ice cube tray that has milk, and an ice cube tray that has juice.
  - Have the students record observations of each tray's contents. They should note that they are all liquids.
  - Then have the students observe the temperature in the room. Provide students with the degrees, if possible, and have them record this observation in their Science Journal.
  - Explain to the students that you are going to place each tray into the freezer overnight and have the student record observations of the temperature of the freezer. (You could also have prepared ice trays ready and continue the lesson. If so, still have students record their observation of freezer temperature.) Provide students with the degrees, if possible.
  - Remind the students that they have already observed what happens to the water when it is placed into the freezer overnight. Ask them to record a prediction for what will happen to the milk and juice based on their observations.
  - On the next day, show the students the trays of water, milk, and juice. Ask students to identify and write down the state of matter in each tray. They expected the water to freeze into ice because they have observed this before. Were their predictions of the milk and juice accurate?
  - Now ask the students to predict what will happen if the water, milk, and juice trays are left out in the room. They should be able to support their prediction by noting that the temperature of the room is above the freezing point (warmer than the frozen milk, juice, and water), and they have already observed what happens to ice when it is left out in the room.
  - Allow the trays to stay out in the room until the contents have melted, and have the students confirm that their prediction is correct by observing that the matter in each tray has become liquid again.

- Optional:
  - For students who require additional support, you may complete Part 1 of the investigation and replace the ice trays in Part 2 with freeze pops.
  - For students who have skills to go further, you could place a tray of ice into a refrigerator, a tray of ice on a table in the classroom, and a tray of ice in a warm, sunny location. The students should record observations that compare the temperatures at each location. Then they should predict which tray of ice will melt first. Based on their observations from the previous experiment they should predict that ice in the warmest location will melt the fastest. Have the students observe which tray of water melted first and record this in their Science Journal. Were their predictions accurate?

Third Grade

Core Concept: Physical Science: Energy Transfer—Electricity and Magnetism

It is essential for students to know: Electricity is a form of energy that can be changed into other forms, including motion, sound, heat, and light (3.P.3A.1). Electricity must travel in paths called circuits to accomplish a task. In the case of light, electricity travels on a circuit composed of wire, switch, battery, and light bulb to accomplish a task (3.P.3A.2). Some materials make it easier for electricity to travel on a circuit than others. Materials that allow transfer of energy are called conductors. Materials that do not allow the transfer of energy are called insulators (3.P.3A.3). A magnet is an object that produces a magnetic field. It can exert forces on other magnets and materials that can be magnetized (3.P.3B.1).

Most Complex ←		→ **Least Complex**
3.P.3A.1 (a) Use models to illustrate energy transformations from electricity to heat, light, or sound.	3.P.3A.1 (b) Use models to illustrate ways electricity can be used.	3.P.3A.1 (c) Identify sources of electricity.
3.P.3A.2 (a) Use models to describe the path of an electric current in a complete simple circuit as it accomplishes a task (e.g., lighting a bulb, making a sound).	3.P.3A.2 (b) Summarize the function of the components of a simple circuit (e.g., wire, switch, battery, light bulb).	3.P.3A.2 (c) Identify the parts of a simple circuit (e.g., wire, switch, battery, light bulb).
3.P.3A.3 (a) Use data and models to predict the results of adding certain materials to circuits.	3.P.3A.3 (b) Use data and observations to classify objects as conductors or insulators.	3.P.3A.3 (c) Identify metal wires as conductors of electricity.
3.P.3B.1 (a) Use data and models to describe and compare the properties (e.g., polarity attraction, repulsion, and strength) of magnets and electromagnets.	3.P.3B.1 (b) Identify the properties of magnets (e.g., polarity, attraction, repulsion, and strength).	3.P.3B.1 (c) Use a magnet to identify which poles attract or repel.

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

3.P.3A.2 (b) Summarize the function of the components of a simple circuit (e.g., wire, switch, battery, light bulb).

- Materials:
  - Battery pack with red and black wires and a switch
  - Batteries required by the battery pack
  - LED light bulb
  - Buzzer or motor for students with visual impairments
  - Examples of electricity in the classroom

- Students will observe parts of a circuit as they are added and removed and then apply what they observed to determine whether different setups of circuits are closed.
- Build a completed circuit with the battery pack, batteries, and light bulb. For students with visual impairments that prevent them from observing light, a buzzer or motor can be substituted for the light bulb.
- Show examples of electricity that exist in the classroom. These examples may include a fan, a light, and a computer.
- Show students the completed circuit. Explain to the students that we know electricity is flowing through the circuit because the light is on.
- Remove the battery and connect the wires in the absence of the battery. The students should observe that the light is off. That is because the battery gives the circuit the energy. A circuit needs a battery. Add the battery back into the circuit.
- Next remove a wire from the circuit. The students should observe that the light is off again. This is because the wire conducts the electricity from one part to another. Add the wires back onto the circuit.
- Next open the switch. The students should notice that the light bulb went off. Close the switch, and the students should notice that the light bulb turns back on. A circuit does not need a switch, but it makes it easy to turn the light bulb on and off.
- Finally, remove the light bulb and connect the wires in the light bulb's place. Explain to the students that the circuit still has energy running through it, but we cannot easily observe it without a light bulb in the circuit.

Activity adaptation for less complexity

3.P.3A.2 (c) Identify the parts of a simple circuit (e.g., wire, switch, battery, light bulb).

- Materials:
  - Two battery packs with red and black wires and a switch
  - Batteries required by each battery pack
  - Two LED light bulbs
  - Buzzer or motor for students with visual impairments
  - Recipe for conductive dough
  - Ingredients to create conductive dough
  - Flashlight (with battery)
- For students who may require additional support, they will create a circuit using different materials.
- Preparation for the activity:
  - Use an Internet search engine to search for recipes for conductive dough. Follow the recipe and have the dough prepared before the activity.
  - Create a complete circuit

- Show a complete circuit to the students and describe each part.
  - The battery is the source of energy for the circuit.
  - The wires allow energy to move from one part to another throughout the whole circuit.
  - The switch also allows energy to continue to flow in the circuit. If we open it, we cut off the energy in the circuit.
  - The light bulb uses energy from the circuit to produce light. When we observe that the light bulb is on, we know that energy is flowing from the battery throughout the circuit.
    - For students with visual impairments that prevent them from observing light, a buzzer or motor can be substituted for the light bulb. Instead of using energy from the circuit to produce light, the buzzer or motor uses energy from the circuit to run.
- Present a flashlight to the students. Explain that the flashlight also uses a circuit to work. There are wires running throughout the body of the flashlight. Can they find the battery? The switch? And the light bulb? (The students should note that the light bulb is on).
- Present the dough to the students. Explain to students that they will create a complete circuit with the dough.
- Make the circuit using a battery pack, a light bulb, and the dough.
  - Steps:
    - Form two balls with the dough. Place them next to each other so that they are close enough but not touching.
    - Place a wire from the LED light bulb into each piece of dough.
    - Place the black wire from the battery pack into one piece of dough and place the red wire from the battery pack into the other piece of dough.
    - Watch the light bulb turn on. (If the light bulb does not turn on, flip the light bulb).
- Discuss with the students the pieces of the circuit you just created.

<u>Activity adaptation for more complexity</u>

3.P.3A.2 (a) Use models to describe the path of an electric current in a complete simple circuit as it accomplishes a task (e.g., lighting a bulb, making a sound).

- Materials:
  - Battery pack with red and black wires and a switch
  - Batteries required by the battery pack
  - LED light bulb
  - Buzzer or motor for students with visual impairments
  - Diagram of a complete circuit on an interactive whiteboard or chart paper
- For students who have the skills to go further, show a diagram of a complete circuit and describe each part of the circuit. Explain to the students that they will use the diagram to construct a circuit.
- Ask the students how many batteries you will need, how many switches, and how many light bulbs. Then count how many wires you will need to connect all of the parts.

- Before constructing the circuit, ask they students how they will know if the circuit is working. Before you start constructing the circuit, they should note that the light bulb will indicate if it is working.
- First build the circuit. Ask the students if the circuit is working.
- Then ask what parts can be replaced by other parts so that energy is still flowing through the circuit. Any part can be substituted or added, but a battery must always be present.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

3.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.

3.P.3A.3 (a) Use data and models to predict the results of adding certain materials to circuits.

- Materials:
  - Battery packs with red and black wires and a switch
  - Batteries required by the battery pack
  - One LED light bulb
  - Buzzer or motor for students with visual impairments
  - Recipe for conductive dough
  - Ingredients to create conductive dough
  - Recipe for insulating dough
  - Ingredients to create insulating dough
  - Science Journals
  - Crayons or other coloring utensils
- For students who may require additional support, they will create a circuit using different materials.
- Preparation for the activity:
  - Use an Internet search engine to search for recipes for “conductive dough” and “insulating dough.” Follow the recipes and have the doughs prepared before the investigation.
- Present the ‘conductive’ dough to the students. Explain to students that they will create a complete circuit with the dough.
- Make the circuit using a battery pack, a light bulb, and the conductive dough.
  - Steps:
    - Form two balls with the dough. Place them next to each other so that they are close enough but not touching.
    - Place a wire from the LED light bulb into each piece of dough.

    - Place the black wire from the battery pack into one piece of dough and place the red wire from the battery pack into the other piece of dough.
    - Watch the light bulb turn on. (If the light bulb does not turn on, flip the light bulb).

- Extend students' learning of electricity by telling them that you will replace the 'conductive' dough with another dough (the insulating dough). Ask students what they think will happen when you replace the dough. Have students either draw their predictions in their Science Journal or dictate their predictions to you.
- Following the steps above, rebuild the circuit with the nonconductive dough and observe what happens. (The light bulb will not turn on.)
- Discuss with students the fact that some materials conduct electricity better than others. For example, metal conducts electricity, while wood does not.

Third Grade

Core Concept: Earth Science: The Earth's Materials and Processes

It is essential for students to know: Rocks, minerals, and soil are the Earth's materials that are classified based on their characteristics (3.E.4A.1). The Earth is made up mostly of water, which can be saltwater or freshwater depending on the water feature (3.E.4A.2). The Earth's surface is made of many different landforms (3.E.4B.1). The Earth's land and water features can change slowly or rapidly over time depending on the factors causing the change (3.E.4B.2). Additionally, the Earth's surface can be changed through landslides, volcanic eruptions, floods, and earthquakes (3.E.4B.3). The Earth has many useful resources used for a variety of purposes (3.E.4A.3).

Most Complex ←		→ **Least Complex**
3.E.4A.1 (a) Use data from observations and measurements to describe, compare, and classify the Earth's different materials, including: • rocks—on how they are formed (e.g., sedimentary, igneous, metamorphic) • soils—on their grain size • minerals—on their physical properties or with mineral ID key (e.g., hardness, color, luster) (including rocks, minerals, and soil).	3.E.4A.1 (b) Use data and observations to identify properties of • rocks—for color, grain pieces, patterns; • soils—for humus, sand, and clay; and • minerals—for color luster.	3.E.4A.1 (c) Use models or pictures to identify a rock, soil, or mineral.
3.E.4A.2 (a) Use models to compare the characteristics of oceans, seas, rivers, streams, lakes, ponds, and glaciers.	3.E.4A.2 (b) Use observational data to identify characteristics of oceans, seas, rivers, streams, lakes, ponds, and glaciers.	3.E.4A.2 (c) Identify oceans, seas, rivers, streams, lakes and ponds, and glaciers as a body of water.
*3.E.4A.3 (a) Use informational data to sort resources into categories of renewable and nonrenewable.	3.E.4A.3 (b) Identify a resource as renewable or nonrenewable.	3.E.4A.3 (c) Identify the Earth's nonliving resources (e.g., water and air).
3.E.4B.1 (a) Use models to describe and compare the characteristics of landforms as volcanoes, mountains, valleys, canyons, plains, and islands.	3.E.4B.1 (b) Use models to describe the characteristics of volcanoes, mountains, valleys, canyons, plains, and islands.	3.E.4B.1 (c) Use models to identify volcanoes, mountains, valleys, plains, and islands as the Earth's landforms.

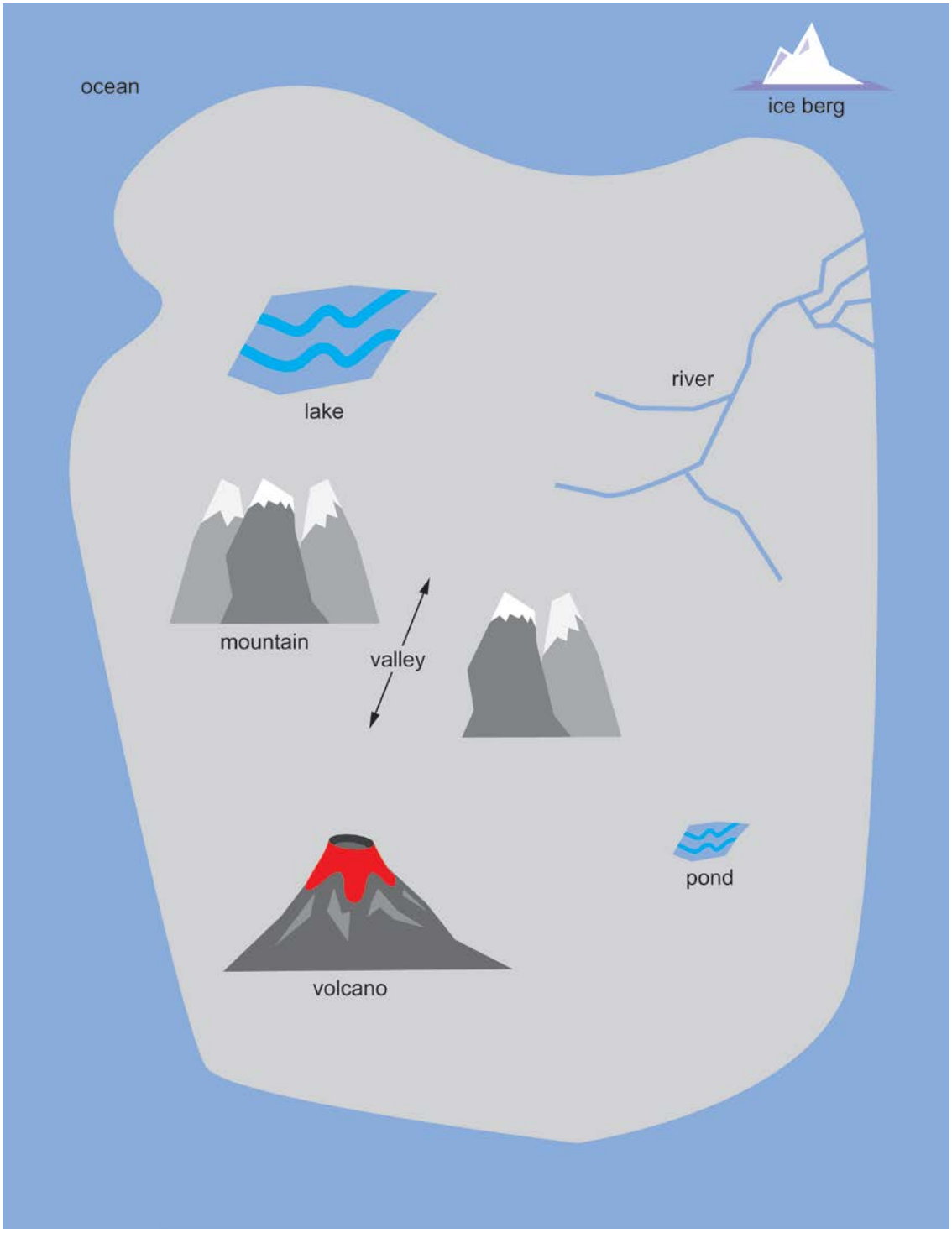
Most Complex ←		→ **Least Complex**
3.E.4B.2 (a) Investigate and use models to characterize fast and slow natural processes (e.g., weathering, erosion, and gravity; landslides, volcanic eruptions, earthquakes, floods) that shape the Earth's surface.	3.E.4B.2 (b) Use models to identify reasons (e.g., weathering, erosion, gravity) for changes of landforms on the Earth's surface.	3.E.4B.2 (c) Use models to identify changes in landforms (e.g., mountains or valleys) over time.
3.E.4B.3 (a) Use informational data to explain how natural events (e.g., fires, landslides, earthquakes, volcanic eruptions, or floods) and human activities (e.g., farming, mining, or building) impact the environment.	3.E.4B.3 (b) Use models to match a natural event (e.g., fires, landslides, earthquakes, volcanic eruptions, or floods) or human activity (e.g., farming, mining, or building) to its environmental impact.	3.E.4B.3 (c) Use pictures to identify a natural event (e.g., earthquake, volcano) or human activity (e.g., farming).

Application of Performance Indicators at the Middle Level—Instructional Activities

3.E.4A.2 (b) Use observational data to identify characteristics of oceans, seas, rivers, streams, lakes, ponds, and glaciers.

- Materials:
  - Unlabeled map on a large poster or interactive whiteboard
  - Three large pieces of paper (optional)
  - Crayons or other coloring utensils (optional)
- Students will label bodies of water on a map and then identify the bodies of water when given characteristics.
- Begin by showing a map to the students that is unlabeled and includes an ocean, a lake, a river, and a pond. As an option, you could include and label landforms, including a mountain, an island, a valley, and a volcano, on the map.
- Show the students labels for "Ocean," "Lake," "River," and "Pond."
- Ask the students, "Which body of water do you think is an ocean?" and follow up with, "What do you observe on the map that makes you think this is an ocean?" The students should note that it is large. They may also note that it becomes deep. Add the "Ocean" label to the map.
- Then ask the students which body of water is the river and what they observe on the map to make them think it is a river. The students should note that the river has a thin, curvy shape that leads to the ocean. Add the "River" label to the map.
- Then point out the two remaining bodies of water on the map (the lake and pond). Ask the students how they are different. They should observe that one is larger than the other. You have two labels left "Lake" and "Pond." Ask the students which is the lake and which is the pond. Then add the "Lake" and "Pond" labels to the map.

- Your map may look like the one below.



- Now that you have the map labeled based on observations, ask the students the following questions about additional characteristics of the bodies of water:
  - One of these bodies of water is much deeper than all of the others. Which is it? (Ocean)

  - Two of these bodies of water are always surrounded by land. Which are they? (Lake and pond)
  - One of these bodies of water flows into other bodies of water. Which is it? (River)
  - One of these bodies of water is always made of saltwater. Which is it? (Ocean)
  - For more challenging characteristics, ask:
    - Which body of water changes the most quickly due to erosion? (River)
    - In which body of water might you find underwater volcanoes or coral reefs? (Ocean)
    - Where do deltas form? (Where rivers meet oceans)
    - Which two bodies of water have large waves? (Oceans and some lakes)
    - When the temperature becomes hotter, which body of water will warm up the fastest? (Pond)
    - Which body of water has currents? (Ocean)

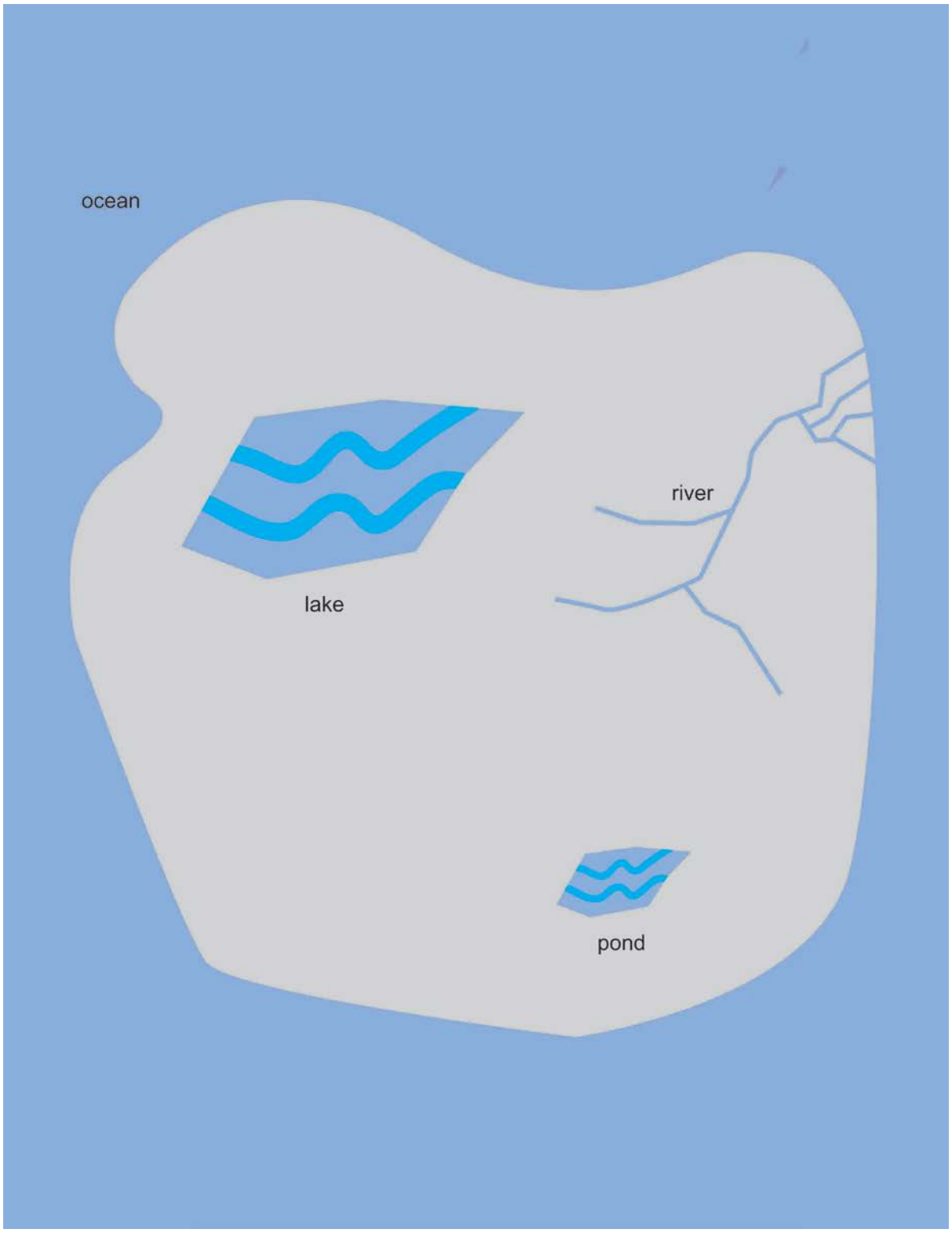
- Use the Internet to search for pictures of seas. Use the pictures to describe characteristics of a sea. With the students, draw an ocean and a sea on the same piece of paper or on the interactive whiteboard. Discuss the similarities and differences between a sea and an ocean. For example, both are large bodies of water, but a sea is smaller.
- Use the Internet to search for pictures of streams. Use the pictures to describe characteristics of a stream. With the students, draw a river and a stream on the same piece of paper or on the interactive whiteboard. Discuss the similarities and differences between a river and a stream. For example, both are bodies of water that flow into other bodies of water, but a river is longer and wider.
- Use the Internet to search for pictures of glaciers. Use the pictures to describe characteristics of a glacier. With the students, draw a glacier and an ocean on the same piece of paper or on the interactive whiteboard. Discuss the similarities and differences between a glacier and an ocean. For example, both are bodies of water, but glaciers are frozen bodies of water.

<u>Activity adaptation for less complexity</u>

3.E.4A.2 (c) Identify oceans, seas, rivers, streams, lakes and ponds, and glaciers as a body of water.

- Materials:
  - Visual examples of places with bodies of water
  - Visual examples of places without bodies of water
  - Visual examples of a body of water
  - Visual examples of a landform
  - Map with bodies of water on a large poster or on an interactive whiteboard
- Students who may need additional support will be identifying bodies of water on a map that is already labeled.
- Begin by providing visual examples of where one finds bodies of water and where one does not find bodies of water. For example, one finds a body of water at the beach, but does not find a body of water in the desert.
- Using visual examples of a body of water and of a landform, discuss the differences between a body of water and a landform with the students. For example, they may say that they can walk on land, but they have to swim in water. They may also note that land is solid and water is liquid. They may be reminding of these things as they identify bodies of water and landforms.

- Provide a map that is in black and white (or grayscale) that has both bodies of water and landforms labeled. The map may appear as the example below:



- Starting with the lake, ask the students if it is a body of water. Then ask them how they know. They may recall that they just described a body of water as liquid, and lakes are made of water.
- Then color in the lake with the color blue, and identify it as a body of water.
- Continue identifying each labeled object as a body of water until all bodies of water have been identified and colored.

Activity adaptation for more complexity

3.E.4A.2 (a) Use models to compare the characteristics of oceans, seas, rivers, streams, lakes, ponds, and glaciers.

- Materials:
  - Globe or map of The United States
  - Topographical map for students with visual impairments
  - Interactive whiteboard or chart paper
- Students who have the skills to go further will locate bodies of water on the globe or the map, find comparable bodies of water based on observable characteristics, and then sequence the bodies of water based on other characteristics.
- Begin with a globe. Have the students locate the Atlantic Ocean on the globe. Ask them how it compares to other bodies of water. They should note that it is much larger (and deeper) than other bodies of water.
  - Based on their observations of the Atlantic Ocean, have the students find another ocean on the globe. How do they know that it is an ocean? Their reasons should be based on the same observations they made about the Atlantic Ocean.
- Next have the students locate the Great Lakes on the globe. Ask them how a lake compares to oceans. They should note that it is much smaller and surrounded by land.
  - Based on their observations of the Great Lakes, have the students find another lake that is similar in size to one of the Great Lakes but on another continent. How do they know that it is a lake?
- Next have the student locate the Mississippi River on the globe. Ask them how they know it is a river. They should note that it flows and empties into a larger body of water.
  - Based on their observations of the Mississippi River, have the students find a river on another continent that empties into an ocean. They should then identify the ocean that the river empties into.
- Finally, students will compare oceans, lakes, and rivers by sequencing them based on three characteristics.
- Create three labels each for “Ocean,” “Lake,” and “River.”
- Write the three characteristics on the interactive whiteboard or chart paper with space beneath each to place the labels:

  Largest → Smallest

  Deepest → Most Shallow

- Together, order the bodies of water from the largest to smallest and deepest to most shallow.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

3.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.

3.E.4B.3 (b) Use models to match a natural event (e.g., fires, landslides, earthquakes, volcanic eruptions, or floods) or human activity (e.g., farming, mining, or building) to its environmental impact.

- Materials:
  - *Volcanoes (The Wonders of Our World) by Neil Morris.*
  - Chart paper or interactive whiteboard
  - 6 cups of flour
  - 2 cups of salt
  - 2 cups of water
  - 4 tablespoons of cooking oil
  - Dirt to decorate baking pan
  - Sticks to decorate baking pan
  - Rocks to decorate baking pan
  - Grass to decorate baking pan
  - Several drops of food coloring
  - 5 drops of dishwashing soap
  - 2 tablespoons of baking soda
  - Several drops of vinegar
  - 1 baking pan
  - 1 liter plastic bottle or aluminum can
  - Science Journals
- Introduce the investigation by reading the book *Volcanoes (The Wonders of Our World)*.
- The goal is to create a volcanic eruption model with your students.
- Discuss what they learned about volcanoes from the book. Explain to them that a volcano is a natural event. Talk about what volcanoes look like, how they are formed, where they are located, and that lava flows from them when they erupt. This can be done in the course of reading, by pausing at the end of each page to review what has been learned.
- Ask students to think about the effects a volcanic eruption can have on the environment. As a group, brainstorm and write the effects on chart paper or on an interactive whiteboard to display in the classroom. Possible responses for the class chart are: toxic gases, acid rain, or destruction of materials.
- Explain that you will be creating a volcano model.

- Procedure:

    1. Mix together 6 cups of flour, 2 cups of salt, two cups of water and 4 tablespoons of cooking oil.
    2. Place the mixture into a baking pan and begin molding the mixture into a clay cone (you can use a soda pop bottle or aluminum can to help you mold the cone shape and opening of the volcano). Allow the clay to dry completely before proceeding.
    3. When the clay is dry, add dirt, sticks, rocks, and grass to the bottom of the pan to represent the environment.
    4. Fill the bottle halfway with warm water (you can add drops of dye for color).
    5. Next, add about five drops of dishwashing soap and 2 tablespoons of baking soda. Finally, slowly add a drop of vinegar. Stand back and watch the volcano erupt. Continue adding more vinegar for additional eruptions.

- Discuss what is happening. How is this affecting the natural environment? What is happening to the environment at the base of the volcano?
- Using their Science Journals, have students reflect on the impact volcanoes have our environment. Tell students to use text or picture representation.

Third Grade

Core Concept: Life Science: Environments and Habitats

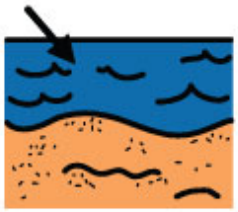
It is essential for students to know: The Earth contains many different types of environments. An environment contains many different kinds of organisms. Organisms can survive only in the environments in which their basic needs are met (3.L.5A.1). Organisms need energy to survive. Energy is passed from producers to consumers through the food chain (3.L.5A.2). Many factors can cause changes in a habitat. These changes can be either beneficial or harmful to the organisms living in the habitat (3.L.5B.1). These changes cause organisms to respond in different ways (3.L.5B.2). A fossil is the remains of a living organism that lived long ago. Fossils give information about life and environments long ago (3.L.5B.3).

Most Complex ←		→ **Least Complex**
3.L.5A.1 (a) Use data and models to describe which characteristics of an environment (e.g., saltwater and fresh-water, deserts, grasslands, forests, rain forests, and polar lands) allow certain organisms to survive.	3.L.5A.1 (b) Use informational data to match the characteristics of an environment (e.g., ocean, lake, desert, forest polar land) to organisms that can survive there (e.g., forests have trees for to shelter birds, grasslands have grasses for buffalos to eat, polar land is cold for penguins).	3.L.5A.1 (c) Identify basic needs of an organism (e.g., air, food, water, shelter, space).
3.L.5A.2 (a) Use models to illustrate a simple food chain with a producer and two consumers and to recognize how organisms obtain energy.	3.L.5A.2 (b) Use observational data to classify organisms as producers or consumers.	3.L.5A.2 (c) Identify green plants as producers and animals as consumers.
3.L.5B.1 (a) Obtain information to predict and explain how changes (e.g., those that occur naturally or those caused by organisms) in habitats can be beneficial or harmful to the organisms that live there.	3.L.5B.1 (b) Match changes in habitats with the ability of plants and animals to survive (e.g., the space available for trees to grow is reduced when new housing is built).	3.L.5B.1 (c) Identify a change in a habitat (e.g., flood, tree cutting) as helpful or harmful to an organism.
3.L.5B.2 (a) Use models to explain how changes in a habitat may cause plants and animals to respond in different ways (e.g., hibernating, migrating, responding to light, death, extinction).	3.L.5B.2 (b) Use observational data and illustrations to describe changes (e.g., cold or drought means less food, more light) in a habitat and possible responses (e.g., hibernating, migrating, death, growing taller) of the plants and animals.	3.L.5B.2 (c) Match changes in a habitat to plant and animal responses.
3.L.5B.3 (a) Compare a fossil with a present-day organism of similar species, noting similar characteristics.	3.L.5B.3 (b) Match fossil to type of environment.	3.L.5B.3 (c) Use models or pictures to identify an object as a fossil.

Application of Performance Indicators at the Middle Level—Instructional Activities

3.L.5B.3 (b) Match fossil to type of environment.

- Materials:
  - Chart paper or interactive whiteboard
  - Models of fossilized remains and imprints
  - Images of various fossils
  - Tape or other adhesive to place the images on the board
- The goal of this lesson is for students to match a fossil to a type of environment.
- Explain to students that they are going to take on the role of a paleontologist. A paleontologist is a scientist who studies fossilized remains of organisms, including plants and cell life.
- Begin the lesson by discussing fossils. A fossil is something left from a living thing that existed long ago. Many fossils are plants and animals that are extinct. This means there are no longer any of them living on Earth.
- Talk about how fossils can give us clues about the type of environment the animal lived in long ago. These environments could the ocean, a forest, or the desert. Next, create a chart with three columns labeled "Ocean," "Forest," and "Desert" and include a photograph or picture symbol of each environment in the heading.

Ocean	Forest	Desert
		

- Next, gather various types of fossils (e.g., leaves, fish, bones, teeth, insects, shells). These can be images of fossils or models of fossilized remains and imprints. Give each student a fossil and allow him or her time to look at it. Ask students to think about what type of animal the fossil came from. Which type of environment might the animal have lived in?
- Have students take turns sharing with the class their responses and their reasoning. Then, students will place their fossils on the chart in the environment they think their animal lived.

Activity adaptation for less complexity

3.L.5B.3 (c) Use models or pictures to identify an object as a fossil.

- Materials:
  - Models of fossilized remains and imprints and corresponding images
  - Images of the plants and animals from which the fossils were made
  - Chart paper, board, or wall
  - Tape or other adhesive to place the images on the board
- For students who need additional support, create a simplified version of the prior lesson.
- Begin the lesson by discussing fossils. A fossil is something left from a living thing that existed long ago. Many fossils are plants and animals that are extinct. This mean they are no longer living and none of their kind remain on Earth.
- First, show students different types of fossils (e.g., leaves, fish, bones, teeth, insects, shells) and their corresponding picture and talk about the features of the fossils.
- Next, show images of plants and animals from which the fossils were made. Tell students that a fossil is similar in size and shape to the living organism that made it. Give each student a turn to match each fossil with its living organism. Place the fossil and the organism on the board.

Activity adaptation for more complexity

3.L.5B.3 (a) Compare a fossil with a present-day organism of similar species, noting similar characteristics.

- Materials:
  - Chart paper, board, or wall
  - Images of fossils or models of fossilized remains and imprints
  - Access to outside
  - Leaves found outside
  - Shells found outside
  - Science Journals
- For students who have skills to go further, first, provide them with an actual fossil or picture of a fossil. This could be a fossil leaf or fossil shell.
- Discuss fossils. A fossil is something left from a living thing that existed long ago. Many fossils are plants and animals that are extinct. This means there are no longer any of them living on Earth.
- Talk about different environments in which fossils may be found (e.g., ocean, forest, and desert).
- Next, take students outside and allow them to collect a leaf or a shell.
- As a class, decide what type of traits you will use to compare the fossil leaf and the real leaf, such as their size and shape. If comparing a fossil shell and a real shell, you might compare their texture, shape, and pattern.

- Allow students time to examine the fossil leaf and real leaf. If possible, provide them with a hand lens for closer investigation.
- In their Science Journals, have students record the similar characteristics between the fossil and the real object, or draw an image to show the characteristics of each.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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

3.L.5A.1 (b) Use informational data to match the characteristics of an environment (e.g., ocean, lake, desert, forest polar land) to organisms that can survive there (e.g., forest have trees to shelter birds, grasslands have grasses for buffalos to eat, polar land is cold for penguins).

- Note on Investigation Duration: Constructing the habitat for the organisms may take up to forty-eight hours to complete. Using a water conditioner will reduce the duration by twenty-four hours.
- Organisms needed:
  - Five Goldfish or Tadpoles
  - An aquatic plant such as *Elodea*
- Materials:
  - Internet access (or other ways to research the organisms)
  - Aquarium rocks
  - A small aquarium (at least 5 gallons)
  - Water
  - Thermometer
  - Fish food
  - Water conditioner (optional)
  - Science Journals
- Students will research the conditions required for an organism to survive and construct its habitat. Then they will record observations of the organism.
- Begin by telling the students that they are putting together a habitat for goldfish or tadpoles and an aquatic plant. Introduce the lesson by explaining to students how much space goldfish and tadpoles need to live (about ten gallons per goldfish or tadpole), what temperature they survive in (65-68º F), and how often they need to be fed (once a day). Students can record the information in the Science Journals. To extend this lesson, students can help research the answers to these questions.
- Ask the students to decide on the size of the aquarium based on their research (about ten gallons per goldfish or tadpole). They should also record this in their Science Journals.
- Add water and the rocks to the aquarium. If you do not have conditioner, you will have to let the water stand at least twenty-four hours, or the chlorine may damage the organisms.

- Have students measure the temperature of the water. If it is not room temperature, wait another twenty-four hours and have the students measure it again. Have the students record the temperature each time it is measured until it reaches room temperature.
- Once the conditions are ideal according to their notes, add the plant and the goldfish or tadpole.
- Ask the students how often the goldfish or tadpole will need to be fed.
- Each time the goldfish or tadpoles are fed, have the students record observations about the health of the plant and the goldfish or tadpoles. Do they notice anything else growing in the aquarium? If they observe algae, see the note below.

NOTE: If the aquarium is in an area that receives some light, there may be algae growth on the sides of the tank. If this is the case, you may either clean it or take the opportunity to introduce another organism into the habitat. Add one nerite snail to the tank, and the students will observe that the snail will eat the algae. This is another opportunity to model producers and consumers. Explain to the students that the algae use sunlight to make their own food, so they are producers. The snail then eats the algae, so they are consumers. This can be modeled in a very simple food chain: algae → snail (alignment: 3.L.5A.2 (b) Use observational data to classify organisms as producers or consumers).

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Age 9 on or before September 1 (Grade 4)

Fourth Grade

Core Concept: Earth Science: Weather and Climate

It is essential for students to know: Water changes form and cycles between the Earth's surface and the air. This is done through evaporation, condensation, precipitation, and runoff (4.E.2A.2). There are procedures for collecting and measuring weather conditions in order to understand daily weather conditions. Using data collected through daily or long-term observations and measurements, patterns in weather can be seen. Weather predictions are based on qualitative and quantitative data; they are not just guesses (4.E.2B1). The weather conditions associated with severe weather are different for each type of storm. These conditions have different effects, and there are safety concerns associated with each condition. The three types of severe weather include thunderstorms, tornadoes, and hurricanes (4.E.2B.2). Weather conditions and patterns can be predicted based on weather data collected from various sources. Some of those sources include direct observation and measurement, weather maps, satellites, and radar (4.E.2B.3).

Most Complex ←		→ **Least Complex**
4.E.2A.2 (a) Use models to illustrate how water changes as it moves between the atmosphere and the Earth's surface during each phase of the water cycle (e.g., evaporation, condensation, precipitation, and runoff).	4.E.2A.2 (b) Use models to identify parts of the water cycle. Use models or illustrations to identify how water moves through the water cycle (e.g., evaporation, condensation, precipitation).	4.E.2A.2 (c) Identify clouds, rain, and the sun as elements in the water cycle.
4.E.2B.1 (a) Interpret data from observations, measurements, and simplified weather maps to describe patterns in local weather conditions (e.g., temperature, precipitation, wind speed/direction, and cloud types).	4.E.2B.1 (b) Identify a weather tool (e.g., anemometer, weather vane, rain gauge, thermometer) when given the condition it measures.	4.E.2B.1 (c) Match weather tools (e.g., anemometer, weather vane, rain gauge, thermometer) to the weather conditions that it measures.
4.E.2B.2 (a) Obtain information to describe severe weather phenomena (e.g., thunderstorms, hurricanes, and tornadoes) to identify ways to reduce the impact of severe weather phenomena.	4.E.2B.2 (b) Identify safety precautions to take during severe weather conditions (e.g., thunderstorms, hurricanes, and tornadoes).	4.E.2B.2 (c) Match severe weather conditions (e.g., thunderstorms, hurricanes, and tornadoes) to safety precautions.
4.E.2B.3 (a) Create a chart to compare and predict weather conditions across time or place.	4.E.2B.3 (b) Use data to identify a weather pattern over time.	4.E.2B.2 (c) Record weather conditions and describe weather patterns over time.

Application of Performance Indicators at the Middle Level—Instructional Activities

4.E.2B.2 (b) Identify safety precautions to take during severe weather conditions (e.g., thunderstorms, hurricanes, and tornadoes).

- Materials:
  - Poster(s) listing the steps to take in the event of severe weather (see the bullet below for further guidance on the information that should be included in the poster)
  - Several short news clips of severe weather condition(s)
- The goal of this lesson (or series of lessons, if you choose) is to teach students the steps to take in the event of a severe weather condition. Select the severe weather condition(s) most likely to occur in your area. Your school will have drills and plans in place for responding, but this lesson (or lessons) will give students an opportunity to practice responding quickly and appropriately to the severe weather condition(s) you select. This example uses a tornado, but the steps can be modified for any severe weather condition.
- Develop a poster that lists the steps to follow in the event of a tornado. These steps will be specific to your school, but will likely include: (1) stay calm; (2) follow the teacher to a safe location; (3) crouch low, head down, protect the back of the head with the arms; and (4) stay away from windows and large open rooms like gyms and auditoriums. You also may want to include the steps to follow after an event has happened because this information is often overlooked in school-wide drills. Augment your poster by pairing pictures with important key words to make it easily accessible for your students who are nonreaders or who read below their grade level. Using pictures of real objects will help nonreaders comprehend the words. Another idea to help increase students' comprehension is to use pictures of your students performing the steps. Keep the steps short and make the print large enough to read easily.
- In a group activity, introduce the lesson by showing short news clips of the severe weather condition. If possible, draw connections to local weather events with which the students' will likely be familiar. Tell students that when severe weather happens, it is important to stay safe and be prepared. Today, we are going to talk about the steps to take to be prepared when there is a tornado.
- Read each step on the poster one at a time. Then, have students take turns reading each step with you. Last, quiz students about specific steps. For example, ask student what they do first? Second? Last? After the poster has been read several times by different students, show students where the poster will be placed in the classroom so they can read it for themselves.
- Practice the steps described on the poster. As you practice, repeat the steps out loud for the students. For example, say, "The first step on the poster is to stay calm." Look at students and point out students who are behaving calmly. If necessary, point out behavior that is not calm and tell students what would be a more appropriate behavior. Continue by saying, "The next step is to follow me to a safe location. Our safe location is the hallway outside of this room. Everyone follow me to the hallway." Continue until all of the steps have been completed.
- Repeat this lesson until students have a solid understanding of the steps to take in the event of a tornado.
- Repeat this lesson format for other severe weather events as appropriate for your school and location.
- Develop alternative steps for students who have other special needs (e.g., students who are deaf or blind, students who use a wheelchair).

Activity adaptation for less complexity

4.E.2B.2 (c) Match severe weather conditions (e.g., thunderstorms, hurricanes, and tornadoes) to safety precautions.

- Materials:
  - Chart paper or interactive whiteboard
- For students who need additional support, focus on one of the severe weather condition that your school has plans in place to respond to.
- With the class, write a social story that includes the steps to stay safe (i.e., precautions) for an appropriate severe weather condition. Write each step as a class and use a picture to represent each step.

Activity adaptation for more complexity

4.E.2B.2 (a) Obtain information to describe severe weather phenomena (e.g., thunderstorms, hurricanes, and tornadoes) to identify ways to reduce the impact of severe weather phenomena.

- Materials:
  - Science Journals
- For students who have the skills to go further, the class can discuss ways in which the threat of severe weather can be reduced for people. For example, when it rains a lot, local rivers can flood. Flooding can cause damage to property and endanger people's lives. Assist students with researching some things people can do to minimize the damage a flood can cause (e.g., if you live at the beach, how would you build your house to avoid flooding?). Have the students record these precautions in their Science Journals.
- Optional: Schedule a time for someone who has experience working with severe weather (e.g., a fireman or a meteorologist) to come speak with the class. Before the person comes to speak to the class, prepare interview questions as a class.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

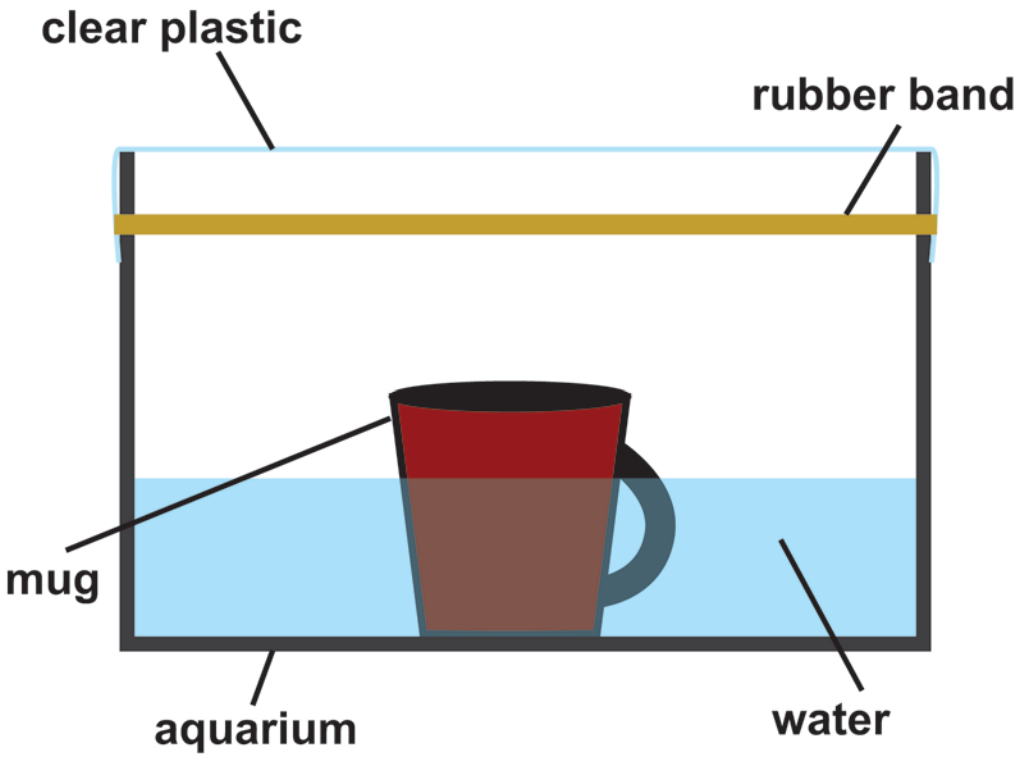
4.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

4.E.2A.2 (b) Use models to identify parts of the water cycle. Use models or illustrations to identify how water moves through the water cycle (e.g., evaporation, condensation, precipitation).

- Materials:
  - Two see-through plastic tubs or aquaria
  - Very warm water
  - A sheet of clear plastic wrap
  - Rubber band
  - Two dry ceramic mugs (like a coffee mug)
  - Ice

- Introduce the water cycle by singing a song with the class. You may use the Internet to search for songs related to the water cycle.
- Create a water cycle.
- Procedures:
    1. Pour 2–3 inches of water into both aquaria.
    2. Place the mugs in the center of each. Be careful not to splash any water into them.
    3. Cover the top of ONE aquarium tightly with the plastic wrap. Leave the other uncovered.
    4. Place ice on the top of the plastic wrap right over the ceramic mug.
    5. Have a student come up and check each mug for moisture. Tell them that you think you can get water to move into one of the mugs without touching it or the water. Take their predications on which one this will happen to and why.

- Observe the surface of the water in both aquaria. In both, students may see steam rising from the water. But what happens to the mist in each aquarium?
- In the covered one, the "mist" that forms on the plastic wrap will change into larger drops of water that will begin to drip. When this happens, continue watching for a few minutes, and then carefully peel back the plastic. Is the coffee mug still empty? Where did the water in the cup come from? (Pay attention for misconceptions such as it "seeped through from the outside.") Compare to your control mug. Water from the "ocean" of water in the bowl evaporated.
  It condensed to form misty "clouds" on the plastic wrap. When the clouds became saturated, it "rained" into the mug!



Fourth Grade

Core Concept: Earth Science: Stars and the Solar System

It is essential for students to know: The Earth is a planet that orbits the sun. Other planets orbit the sun. Some planets are closer to the sun than the Earth, and others are farther away. The sun, the moon, and the Earth have different properties (4.E.3A.1). Planets in our night sky change positions and are not always visible from the Earth as they orbit our sun. Telescopes and compasses are tools that aid in the study of objects in outer space (4.E.3A.3). The moon reflects light from the sun. Because of the positions of the sun, the moon, and the Earth, the moon appears to change shape. The amount of reflected light from the moon that is seen from the Earth determines the phase. The changing shapes of the moon are called phases. The moon and the Earth pull on each other because of gravity (4.E.3B.1). The Earth rotates (spins) on its axis and completes one rotation in 24 hours. Because of this rotation, only the side of the Earth facing the sun is lit and therefore experiences day; the side of the Earth not facing the sun experiences night (4.E.3B.2). Objects on the Earth cast shadows that help show the Earth's rotation. The angle of the sun, low in the sky to higher in the sky, changes the length of the shadow cast behind an object (4.E.3B.3). The Earth has distinct seasons which result from the tilt of its axis and its revolution around the sun (4.E.3B.4). Refer to the science support document for more guidance.

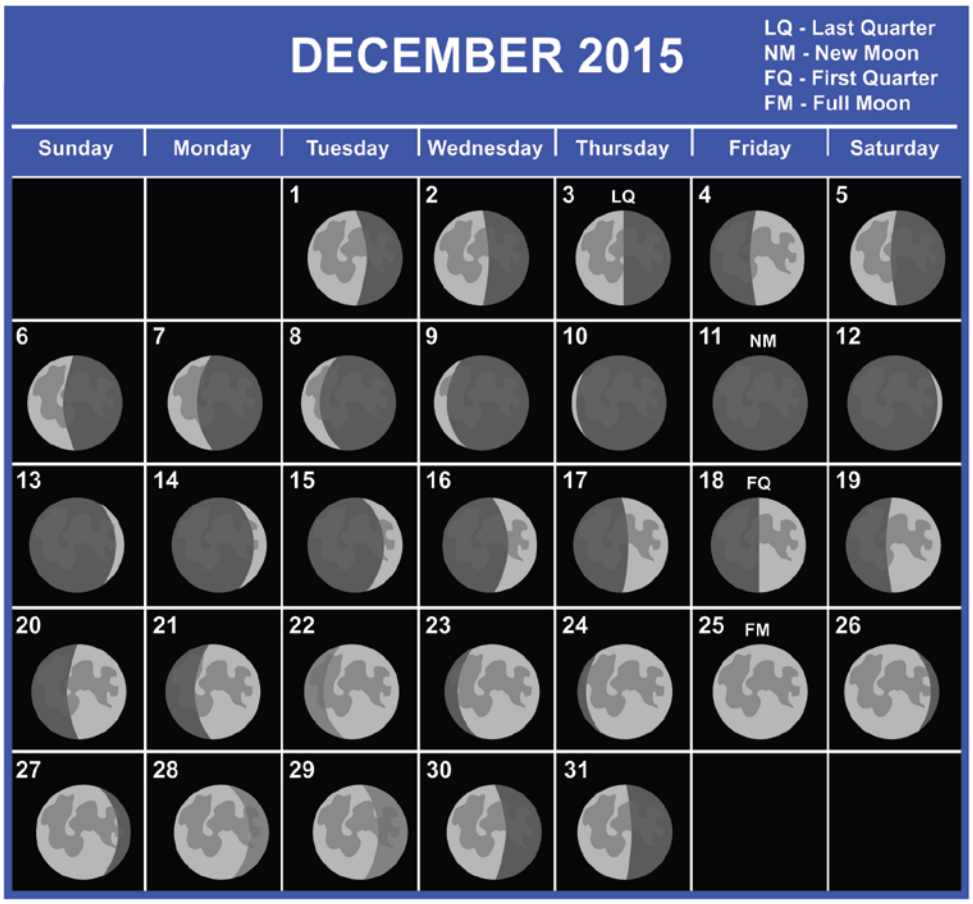
Most Complex ←		→ **Least Complex**
4E.3A.1 (a) Compare or contrast the sun, Earth's moon, and the planets that are found in the solar system.	4.E.3A.1 (b) Build a model of the solar system, including the sun and planets.	4.E.4A.1 (c) Identify what can be found in the solar system.
4E.3A.3 (a) Indicate the importance of astronomy in navigation and exploration (including the use of telescopes and compasses).	4E.3A.3 (b) Identify the importance of using a compass or telescope to find a location.	4E.3A.3 (c) Identify instruments that you would use to find a location in space (e.g., telescope, compass).
4.E.3B.1 (a) Describe patterns from observations in the location, movement, and appearance of the moon throughout the year.	4.E.3B.1 (b) Identify patterns in the location, movement, and appearance of the moon throughout the month.	4.E.3B.1 (c) Identify changes in the appearance of the moon throughout the month.
4.E.3B.2 (a) Use models to explain how day and night result from the Earth's rotation on its axis.	4.E.3B.2 (b) Use models to demonstrate how the Earth rotates on its axis, resulting in day and night.	4.E.3B.2 (c) Use models to demonstrate the Earth's rotation.
4.E.3B.3 (a) Use models to identify the time of day by the length of shadows and use illustrations to identify the sun's locations when shadows are long or short.	4.E.3B.3 (b) Recognize that the length of shadows changes during the day.	4.E.3B.3 (c) Recognize a shadow.

Most Complex ⟵		⟶ **Least Complex**
4.E.3B.4 (a) Use models to describe the factors (e.g., tilt, revolution, and angle of sunlight) that result in the Earth's seasonal changes.	4.E.3B.4 (b) Explain that South Carolina has four seasons due to the Earth's position relative to the sun.	4.E.3B.4 (c) Identify that there are four seasons in South Carolina.

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

4.E.3B.1 (b) Identify patterns in the location, movement, and appearance of the moon throughout the month.

- Materials:
  - Interactive whiteboard or chart paper with a map of the moon phases for the current month
  - Package of sandwich cookies with a filling that is a different color than the color of the cookie (optional)
- The purpose of this lesson is to familiarize students with patterns in the location, movement, and appearance of the moon throughout the month. Begin the lesson by showing students a map of the moon phases for the current month and appropriate hemisphere (i.e., northern or southern). An Internet search will yield images similar to the following:



- This map shows the appearance of the moon for each day of the month. As you explore the map together, ask students to:

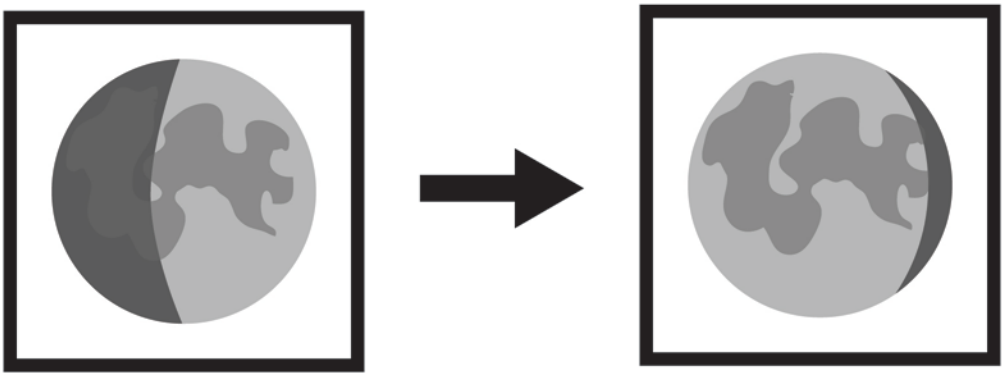
    1. Find today's date and say what the moon will look like tonight.
    2. Find the date on which the moon appeared to be full.
    3. Find the date on which the moon appeared to be new.
    4. Identify any patterns in the moon's appearance (Does it appear to grow bigger or smaller as time passes?).

- As an extension, use sandwich cookies (with a filling that is a different color than the color of the cookie) to show the phases of the moon. An Internet search will yield examples of how to create phases of the moon with the sandwich cookies.

<u>Activity adaptation for less complexity</u>

4.E.3B.1 (c) Identify changes in the appearance of the moon throughout the month.

- Materials:
    - Interactive whiteboard or chart paper
- For students who need more support, simplify the questions that are asked in the lesson above. For example, show students pictures of two moon phases and ask them if the moon looks bigger in the second one (student answers yes or no). Choose two moon phases that are very different at first, and then as the student has success, slowly introduce pictures of moon phases that are more similar. Another way to differentiate this activity is to show students two pictures of moon phases and ask students to tell you if the moon appears bigger or smaller in the second picture. They can respond verbally or by showing a response card for "bigger" or "smaller." A graphic organizer like the one below might be useful in communicating to students the direction of the pictures they are comparing.



Activity adaptation for more complexity

4.E.3B.1 (a) Describe patterns from observations in the location, movement, and appearance of the moon throughout the year.

- Materials:
  - Venn diagram or T-chart on interactive whiteboard or chart paper
- For students who have skills to go further, use a Venn diagram or T-chart to compare two or more moon calendars with students. For example, students could:

  1. Compare the appearance of the moon on the same day of different months.
  2. Compare the patterns in changes of the moon's appearance over two or more months.
  3. Compare the date of each month when the moon's appearance was full and new (Are the dates the same or different?).

- Next, have students dictate conclusions drawn from their comparison and make inferences about why there are similarities and differences.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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

4.E.3B.3 (b) Recognize that the length of shadows changes during the day.

- Note on Investigation Duration: The following investigation will take between a few hours to an entire school day, requiring the students to revisit the investigation every one to two hours.
- Materials:
  - Pavement chalk
  - Watch or clock
  - Object that can create a shadow (optional)
- Note: You will want to pick a sunny day without clouds to complete this activity
- Students will observe how their shadows change throughout the day.
- Choose a sunny day and go to a large flat area that can be written on in chalk (like a playground).
- Pair students up. Each student takes turn tracing the other's shadow on the pavement. Write the student's name next to the shadow and the time.
  - If students are unable to draw each others' shadow, you may consider the following alternatives:
    - An adult could draw each student's shadow
    - Students and/or teachers can draw the shadow of an object
- Come back in one to two hours and repeat.

- If possible, come back again one to two hours later and repeat.
- At each observation, have students look at each others' shadows. Is there a pattern to how the shadows change that is true for all students? (Depending on the hour of the day, the shadows may become longer or shorter.)
- Discuss why this might be the case. What causes a shadow? How does that change throughout the day? Make a prediction about where the shadow would be in another two hours. What about the same time tomorrow? (The changes will be the same) What did you observe? What did the shadows do?

Fourth Grade

Core Concept: Physical Science: Forms of Energy—Light and Sound

It is essential for students to know: An object's visibility is dependent on the amount of light given off, or reflected, by the object (4.P.4A.3). Light behaves differently when it strikes different materials. Transparent materials allow light to pass through, while translucent materials only allow some light to pass through them. Opaque materials do not allow any light to pass through them (4.P.4A.5). Sounds can have different pitches and volumes (4.P.4B.1). Changes in vibration alter the pitch and volume of a sound (4.P.4B.2).

Most Complex ⟵		⟶ **Least Complex**
4.P.4A.3 (a) Use data and models to explain how the visibility of an object is related to light.	4.P.4A.3 (b) Use models to recognize that light can be reflected or absorbed.	4.P.4A.3 (c) Use models to recognize that light travels through some objects and not others.
4.P.4A.5 (a) Investigate and use models to describe how light behaves when it strikes transparent (water, air), translucent (waxed paper), and opaque materials (construction paper, wood).	4.P.4A.5 (b) Investigate and use observational data to classify types of materials as transparent or opaque.	4.P.4A.5 (c) Identify transparent materials from observations.
4.P.4B.1 (a) Investigate and use models to identify ways different variables (e.g., with different thickness, length, tension, force, distance) affect properties of sound (e.g., pitch and volume).	4.P.4B.1 (b) Use models to identify the pitch (high/low) and volume (loud/soft) of a sound.	4.P.4B.1 (c) Use models to recognize the difference between loud and soft sounds.
4.P.4B.2 (a) Interpret data from observations and measurements to describe how a change in vibration affects the pitch and volume of a sound.	4.P.4B.2 (b) Identify ways to change the pitch and volume of a sound.	4.P.4B.2 (c) Identify sounds by pitch and volume.

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

4.P.4B.2 (b) Identify ways to change the pitch and volume of a sound.

- Materials
  1. Instruments or other objects that make sound
  2. Interactive whiteboard or chart paper
- Tell students that some sounds are high and some are low. Pitch is how low or how high a sound is. If a sound vibrates very slowly, the pitch will be low. If a sound vibrates very fast, the pitch will be high.

- Pitch is described as high or low. Volume is described as loud or soft. The materials you use in this lesson can vary depending on what you have available. This is a good opportunity to collaborate with the music teacher at your school. They may be able to provide some instruments that students can play.
- Ask students to think about the sounds the instruments in an orchestra make. The instruments make vibrations that travel in waves. When the vibrations from the instruments reach your ear, you hear them as sound. Use different instruments to show a differentiation in pitch among the instruments.
- Explain that volume is different than pitch, and show examples of how this difference can occur. You can make music or your voice louder or softer. Volume and pitch work together to make sounds.
- First, talk about how sounds are measured (volume and pitch). Demonstrate both volume and pitch using an instrument or two, introducing the words "soft and loud" and "high and low." Next, ask students to describe the sound's volume as you strike the keys or strings gently (The volume is soft.) or hard (The volume is loud.). Ask students why the sound changed (e.g., the piano key was tapped gently versus hard). Allow students to explore changes in volume with other instruments. After they have explored a couple of instruments, ask them to predict how the sound will change in volume if you (a) strike a key gently or (b) pluck a string strongly. Next, talk about how the pitch of sound can change (from high to low or vice-versa). Use an instrument or two to demonstrate high and low pitches, asking students to identify the pitches as you go. Give students a chance to explore changes in pitch with a couple of instruments, and then see if they can predict whether a pitch will be high or low. Incorporate writing at the end of the activity by asking individual students to complete the following concept statements. Fill in the blanks on chart paper or an interactive whiteboard.
  - Volume and pitch work together to make <u>sounds</u>.
  - <u>Pitch</u> can be high or low.
  - <u>Volume</u> can be loud or soft.

<u>Activity adaptation for less complexity</u>

4.P.4B.2 (c) Identify sounds by pitch and volume.

- For students who need more support in the lesson above, reduce the number of concepts they are learning by introducing one concept at a time (pitch or volume) and teaching it to mastery before introducing the other.
- Of these two concepts, students may be most familiar with the concept of volume, so introduce it first. Talk about how volume can change (loud or soft). Demonstrate sounds with a soft volume (e.g., whisper, rain falling). When students can identify sounds that have a soft volume, introduce sounds that are loud (e.g., TV or radio with the volume turned up, lawn mower running, the whistle used by the PE teacher). When they can successfully identify sounds that are loud, play both types of sounds consecutively (one loud sound and one soft sound) and ask them to identify the one that is soft (or loud). Some students may be able to make the sounds change from soft to loud by turning a knob or pushing a button. If so, this would be a good cause and effect activity.
- After students are successful in identifying sounds by volume, introduce the concept of pitch (high and low) in the same way.

Activity adaptation for more complexity

4.P.4B.2 (a) Interpret data from observations and measurements to describe how a change in vibration affects the pitch and volume of a sound.

- Materials
  1. Instruments
- For students who have skills to go further, one way to extend the activity at the middle level is to have students observe how instruments (e.g., piano, harp, guitar, xylophone, chimes) are designed to produce sound. For example, some of the tubes that make up the chimes are shorter than others, and they are arranged from shortest to longest in length.
- Have students play an instrument in different places and record their findings (short plates on the xylophone are higher in pitch than the long plates; the thick strings on the guitar are lower in pitch than the thin strings).
- After exploring several instruments, ask students to draw conclusions based on what they found and record their findings in their Science Journals. They will observe shorter strings or plates produce a higher pitch. You may want to give them an outline or a word bank from which to work.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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

4.P.4A.3 (a) Use data and models to explain how the visibility of an object is related to light.

- Materials
  - Transparent materials (e.g., plastic wrap, plastic containers, objects made of glass)
  - Translucent materials (e.g., pieces of mesh, tissue paper, fabric softener sheets)
  - Opaque materials (e.g., file folders, construction paper, solid objects)
  - Flashlight or other light source
  - Graphic organizer on interactive whiteboard or chart paper
  - Light observation worksheet
- Students will be able to recognize transparent, translucent, and opaque objects.
- Procedure:
  1. Tell students that materials can be classified by the amount of light they let pass. (i.e., transparent—most light passes through; translucent—some light passes through; and opaque—no light passes through).

2. Show students three items (e.g., a piece of construction paper, a glass candle holder, and a fabric softener sheet). Ask students to brainstorm how those items are different. Demonstrate for students how to shine a flashlight or other light source through the items.
    a. Using a graphic organizer, work with students to identify which items are translucent, transparent, and opaque. Repeat the procedure with more examples, as needed.
    3. Have students take turns testing an item and recording their findings on the class' graphic organizer.

- Post-activity discussion: Ask students why some materials let in all the light while other items only let in a little. What was different about these materials? (Some of the materials are transparent while some are opaque)

Fourth Grade

Core Concept: Life Science: Characteristics and Growth of Organisms

It is essential for students to know: There are many different types of plants and animals, which can be divided into different groups based on their characteristics (i.e. flowering and nonflowering, vertebrate and invertebrates) (4.L.5A.1). The life cycle of a plant defines different stages of plant development (4.L.5A.2). An animal life cycle varies among species. These differences in development occur from birth through adulthood (4.L.5A.3). Characteristics that plants and animals exhibit through their life cycles are influenced by their parents and the environment (4.L.5A.4). Structural changes to plants and animals allow them to better survive in an environment (4.L.5B.2, 4.L.5B.3).

Most Complex ←		→ **Least Complex**
4.L.5A.1 (a) Obtain information about the characteristics (e.g., cones, fruits, seeds, bones, hair, feathers, scales, gills) of plants and animals to classify plants as flowering (e.g., daisies, apple trees) or nonflowering (e.g., ferns, pine trees) and animals as vertebrate (e.g., mammals, fish, amphibians, reptiles, birds) or invertebrate with hard shells (e.g., insects, spiders, clams, snails).	4.L.5A.1 (b) Match characteristics of animals and plants with the major groups: vertebrates (backbone) vs. invertebrates (no backbone) and flowering (seeds) vs. nonflowering (cones).	4.L.5A.1 (c) Use pictures to identify major groups of plants with flowers and animals (vertebrates vs. invertebrates).
4.L.5A.2 (a) Interpret data from observations and measurements to compare the stages of development of different seed plants (e.g., tomato plants, dandelions, tulips).	4.L.5A.2 (b) Use a model to identify a characteristic from each stage of the plant life cycle.	4.L.5A.2 (c) Use pictures to label the stages in the life cycle of a plant.
4.L.5A.3 (a) Develop and use models to compare the stages of growth and development in various animals (e.g., mammal, bird, reptile, amphibian, fish).	4.L.5A.2 (b) Use illustrations to sequence the stages of an animal life cycle (e.g., cat, owl, turtle, frog, guppy).	4.L.5A.2 (c) Use pictures to identify a stage of an animal life cycle (e.g., human, dog, robin).
4.L.5A.4 (a) Analyze data to determine which characteristics of organisms are inherited from parents and which ones are influenced by the environment.	4.L.5A.4 (b) Use observational data to classify characteristics of an animal or plant that are inherited or influenced by the environment.	4.L.5A.4 (c) Identify characteristics that an animal has inherited from its parents.

Most Complex ⟵		⟶ **Least Complex**
4.L.5B.2 (a) Use observational data and models to explain how structural adaptation (e.g., obtaining resources to make their own food, appearance of fruit and flowers to attract animals, methods for seed dispersal) allow plants to survive.	4.L.5B.2 (b) Use illustrations to match structural adaptations to survival needs (e.g., thorns for protection, color of flowers to attract animals, leaf shape and size to help a plant make food) in an environment.	4.L.5B.2 (c) Match structural adaptation to survival needs (e.g., deep roots to find water). Identify a survival characteristic.
4.L.5B.3 (a) Use observational data and models to explain how structural adaptations (e.g., methods for defense, locomotion, obtaining resources, or camouflage) allow animals to survive in their environments.	4.L.5B.3 (b) Use illustrations to match structural adaptions to survival needs (e.g., claws for defense, long tongue for obtaining food, color for camouflage) in an environment.	4.L.5B.3 (c) Match a structural adaption to survival needs (e.g., legs for movement). Identify a survival behavior.

Application of Performance Indicators at the Middle Level—Instructional Activities

4.L.5A.2 (b) Use a model to identify a characteristic from each stage of the plant life cycle.

- Materials:
  - Interactive whiteboard or chart paper
  - Pictures of plant life cycle stages for sunflowers and other plants
  - Worksheet for students to label the stages of the plant life cycle
  - Coloring utensils (optional)
  - Scissors (optional)
  - Glue or other adhesive (optional)
- Begin this activity by introducing the stages of the plant life cycle. You can use any form of presentation that works best for your students (e.g., interactive whiteboard or chart paper). The sunflower plant life cycle may be a good one to start with, but other plants are fine. If your students are familiar with a particular plant, start there. As you introduce the stages one at a time, illustrate each stage with pictures from real sunflowers.

  1. Seed germination: the beginning of a plant where the seed grows a sprout.
  2. Vegetative: the plant continues to grow bigger and taller.
  3. Bud stage: buds begin to grow on the plant.
  4. Flowering: buds open into flowers.
  5. Ripening: seeds made in the flowers fall to the ground and the cycle begins again.

- Next, introduce a characteristic from each of the stages.
- Last, have students label the stages of the plant life cycle on a worksheet (you may also work as a class and project the plant life cycle on an interactive whiteboard or chart paper). Some writers can choose the words from a word bank; others can cut and paste words to complete the worksheet. Students who are just beginning to use symbols can use pictures of the stages of plant life to complete the worksheet.
- This activity can be repeated using different plants.

Activity adaptation for less complexity

4.L.5A.2 (c) Use pictures to label the stages in the life cycle of a plant.

- Materials:
  - Picture of a completed sunflower life cycle (the life cycle stages should not be labeled) on interactive whiteboard or chart paper
- Beginning with a completed illustration of the sunflower life cycle, describe any stage, and have the students label the stage you are describing. For example, "In this stage, a bud begins to grow on the plant. Which stage is this in your diagram? Let's label that stage 'Bud stage.'"
- Note: Describe the stages out of order at first so that students are focused on the characteristics associated with each stage. Then cut out the stages, mix them up, and practice re-ordering the stages.

Activity adaptation for more complexity

4.L.5A.2 (a) Interpret data from observations and measurements to compare the stages of development of different seed plants.

- Materials:
  - Interactive whiteboard or chart paper
  - Pictures of plant life cycle stages for sunflowers and other plants
  - Pictures of plants or real plants
- For students who have the skills to go further, introduce the stages of the plant life cycle using pictures to represent the characteristics of each stage. When describing each stage, incorporate additional details on the characteristics of each plant stage. For example:

  1. In the germination stage, it takes the sunflower plant two to ten days to germinate and the sprout always grows toward the soil.
  2. At the seedling stage, leaves are no longer than 1 ½ inches in length.
  3. In the vegetative stage, leaves are longer than 1 ½ inches.
  4. In the bud stage, the bud begins to show at the top of the stem and the leaves.
  5. In the flowering stage, once the bud begins to open, it continues facing east (and doesn't move with the sun). It can take up to seven days for the bud to open and it opens from the outside of the plant toward the middle.
  6. In the ripening stage, the plant begins to die and the seeds fall to the ground.

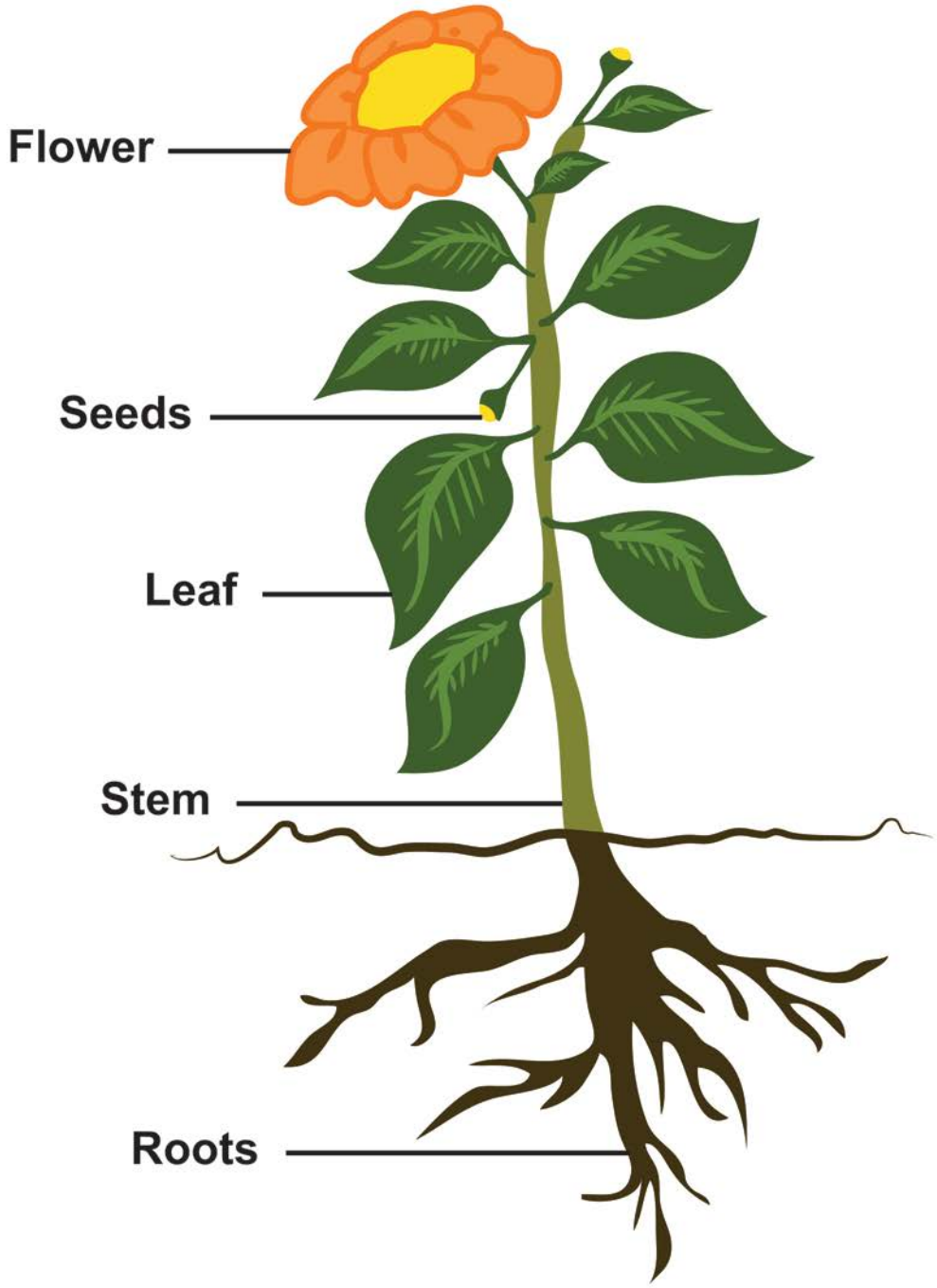
- Using pictures of various plants (or real plants if they are available), students can identify different plant stages through measurement (e.g., measure the size of the plant's leaves to tell if it is the seedling stage or the vegetative stage) or observation (e.g., observe the placement of the sprouts on the seed to know that it is the germination stage, or observe the existence of buds at the top of stem to know that it is the bud stage).

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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

4.L.5A.1 (a) Obtain information about the characteristics (e.g., cones, fruits, seeds, bones, hair, feathers, scales, gills) of plants and animals to classify plants as flowering (e.g., daisies, apple trees) or nonflowering (e.g., ferns, pine trees) and animals as vertebrate (e.g., mammals, fish, amphibians, reptiles, birds) or invertebrate with hard shells (e.g., insects, spiders, clams, snails).

- Materials:
  - Interactive whiteboard or chart paper
- Ask students to discuss and identify the purpose of key features of the flowering plant (You may want to use a diagram or a picture of a plant for the review.).

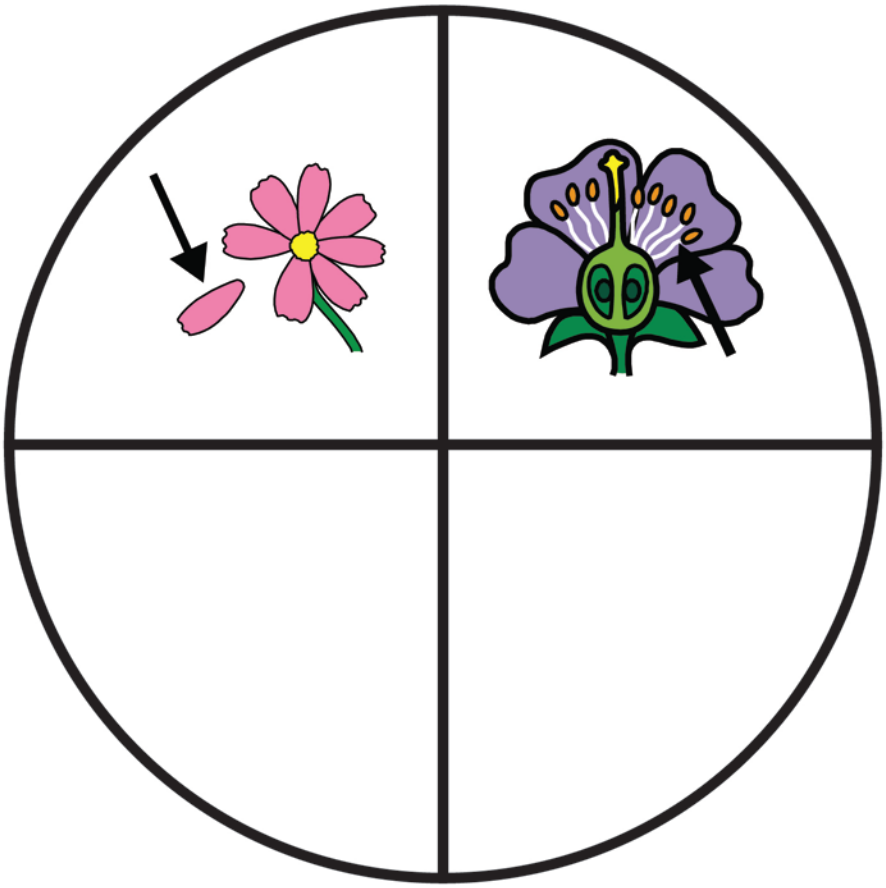


- Introduce the terms: flower, seeds, stem, roots, cones, broad leaves, pine needles.
- Use the following concept circles (see example below):
  - Characteristics of typical flowers (petals and pollen)

- Characteristics of a typical plant (cones or spores)
- Flowering plants (apple tree, strawberry plant, tomato plant)
- Nonflowering plants (pine tree, fern, moss)

- Show students pictures of several different plants and have the students add examples of the concept to the Concept Circles. For students who don't write, pictures of plants can be used. Note that there are a number of concepts that will fit in each circle.

Characteristics of Flowers



- Optional Extension: Students can also complete a chart about the flowers (or plants) that they see. See the chart below as an example.

Topic: Flowering Plants Pick a plant to look at and record what you see.	Q1: Describe the leaf of the plant. What are its functions? What parts do you see?	Q2: Describe the flower. What parts do you see? Is there a flower or fruit?	Own question:	Interesting information:

Plant Name:				
What we know:				
Sources of information:				
Summary				

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Age 10 on or before September 1 (Grade 5)

Fifth Grade

Core Concept: Physical Science: Matter and Mixtures

It is essential for students to know: Matter is anything that has mass and volume and is composed of very small particles. Solids, liquids, and gases are states of matter and can be compared based on their physical properties (5.P.2A.1). Mixtures can be made of various combinations of solids, liquids, and gases. Mixtures are composed of two or more substances that are mixed together but can be separated (5.P.2B.1). Solutions are composed of substances that are mixed together but cannot be easily separated (5.P.2B.3).

Most Complex ⟵		⟶ **Least Complex**
5.P.2A.1 (a) Interpret data from observations and measurements of the physical properties of matter (e.g., volume, shape, movement, and spacing of particles) to explain why matter can be classified as a solid, liquid, or gas.	5.P.2A.1 (b) Use observational data and models to compare the physical properties (e.g., volume, shape, movement, spacing) of solids, liquids, and gases.	5.P.2A.1 (c) Classify matter as a solid, liquid, or gas based on a physical property.
5.P.2B.1 (a) Obtain information to describe what happens to the properties of substances when two or more substances (e.g., solid and solid, solid and liquid, liquid and liquid, and liquid and gas) are mixed together.	5.P.2B.1 (b) Use observational data and models to identify what happens when two or more substances (e.g., solid and solid, solid and liquid, liquid and liquid) are mixed together.	5.P.2B.1 (c) Use models or pictures to identify a mixture as two or more substances that are mixed together.
5.P.2B.3 (a) Use observational data and models to describe or compare mixtures and solutions based on their characteristics (e.g., easily separated, cannot be distinguished as separate).	5.P.2B.3 (b) Use observational data and models to identify different types of mixtures (e.g., solid and solid, solid and liquid, liquid and liquid, and liquid and gas).	5.P.2B.3 (c) Identify mixtures in which the individual materials substances can easily be separated (e.g., salad, sand and water).

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

5.P.2B.3 (b) Use observational data and models to identify different types of mixtures (e.g., solid and solid, solid and liquid, liquid and liquid, and liquid and gas).

- Materials:
  - Four glass containers of similar size
  - Water (enough to fill all four containers)
  - ½ cup to 1 cup of rocks
  - ½ cup to 1 cup of salt
  - One sieve

  - ½ cup to 1 cup of sand
  - ½ cup to 1 cup of oil
- At the beginning of the lesson, teach the following vocabulary words:
  - Mixture: two or more materials mixed or stirred together that do not react chemically (that is, they retain their physical properties)
  - Solution: a special mixture formed when a material dissolves in a liquid and cannot be filtered out
- Explain to students that a mixture occurs when two or more materials are mixed together and the materials retain their physical shape. Solids can be mixed with solids, solids and liquids, liquids and liquids, and liquid and gas. Demonstrate this idea through a series of experiments:
  - Mix rocks and water together, and then pour the mixture into a sieve. Show students the result. It is a mixture because both materials retained their physical properties (i.e., the rocks are still rocks and did not react in the water).
  - Mix sand and water together, and then pour the mixture into a sieve. Show students the result. The sand and water created a mixture because the sand and water can be easily separated.
  - Mix oil and water together. The oil will rise to the top of the mixture. Ask students if it is a mixture or a solution. (Because the two materials can be easily separated, it is a mixture).
  - Mix salt and water together, and then pour the mixture into a sieve. Show students the result. The salt and water mixed together to form a solution, a special kind of mixture. If the water was boiled away, the salt would remain. This separates the water and salt solution.

Activity adaptation for less complexity

5.P.2B.3 (c) Identify mixtures in which the individual materials substances can easily be separated (e.g., salad, sand and water).

- Materials:
  - Materials familiar to the students that can be used to create a mixture
- For students who need a less complex lesson, teach just the concept of mixture. Demonstrate the idea of a mixture with materials familiar to the students (e.g., Jell-O salad with fruit, trail mix, milk and cereal).
- Ask students to mix the materials together to make a mixture.
- Then ask the students if the materials in the mixtures can be separated. Emphasize that this is a property of a mixture.

Activity adaptation for more complexity

5.P.2B.3 (a) Use observational data and models to describe or compare mixtures and solutions based on their characteristics (e.g., easily separated, cannot be distinguished as separate).

- Materials:
  - Interactive whiteboard or chart paper
  - Three glass containers of similar size

  - Water (enough to fill all three containers)
  - ½ cup to 1 cup of sugar
  - ½ cup to 1 cup of sand
  - ½ cup to 1 cup of oil
- Demonstrate a solution by dissolving sugar into water. Can you see the grains of sugar? (No).
- Demonstrate a mixture by adding sand to water. Allow gravity to separate the two.
- Then demonstrate adding oil to water and allow them to sit. Can you distinguish between the oil and the water? (Yes.) Is this a solution or a mixture? (Mixture.) Have students explain their reasoning.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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.

5.P.2A.1 (b) Use observational data and models to compare the physical properties (e.g., volume, shape, movement, spacing) of solids, liquids, and gases.

- Students will model phases of matter.
- Materials:
  - Ice cubes
  - Water
  - Warm water
  - Hot plate and pot or kettle
  - Petri dish or small container (optional)
  - Small manipulatives (optional)
  - Science Journals
- Bring water on the hot plate to a boil until it gives off steam.
  - Option: If you would prefer not to use a hot plate in the classroom, you could use a virtual lab to demonstrate how temperature affects solids, liquids, and gases.

- Begin by examining water in three different phases. Show the ice, water and steam. Ask students what all three are made of (water). What's different about them? (Temperature, shape, form—solid, liquid or gas.) Make some observations about them:

	Ice	Liquid water	Steam
Made of	Water	Water	Water
Temperature	Cold	Medium	Hot
Shape?	Has a shape	It takes on the shape of its container*	No shape
Can things pass through it?	No**	Yes	Yes

*You can demonstrate this by pouring the water into a different-shaped container.

**Demonstrate by poking.

- Say that you're going to make a model of solids, liquids and gases by acting out what the particles do in each.
  - "First, we're going to act out what it is to be a solid. In a solid, each molecule is locked into place with the molecules next to it. You are going to be these molecules. So, each person reach out and grab the wrist of someone near them with both hands. You all are a solid. Let's see if the solid you made behaves like a solid. Does it have a shape? (Trace the edges of the mass of students, yes it has a shape.) Can I pass something through it? (Try to walk through.) Nope."
  - "OK, now we're going to act out what it means to be a liquid. In a liquid the particles are still touching, but they are not locked in place. They are constantly moving. As they move, they change which molecules they are touching."
  - Demonstrate with two students. "If I were a molecule of a liquid, I would hold onto student A, and then when I move, I'd grab onto a new molecule. As I kept moving, I'd grab onto different molecules. Instruct students to grab each other (gently) on the forearm or shoulder while they move and try it. Now try the same two tests. Does it have a fixed shape? Are the edges clear? No, they are constantly moving. Can I pass through the liquid? Yes, I can." Also notice with the students that they take up more space as a liquid than they did as a solid.
  - Finally demonstrate a gas. In a gas, the molecules are moving but not touching. Have students act this out. Notice how much space they take up, and that you can move freely through the gas. Also notice that the gas has no shape. Have the students draw their observations in their Science Journals.
    - (Optional: Phase change modeling)

- Have students become a solid again. Draw their attention to the fact that you haven't talked about the temperature difference between the phases. You'll make a model of how temperature affects phases.
- Have a small group of students form a solid again. Now say that when heat is added to a substance, each molecule starts to move and wiggle; the more heat, the more it moves and wiggles. Try it, adding more and more heat by wiggling, until it is hard to keep holding on. When some people lose their grip, tell them to not to grab on again. When the molecules are moving too fast to hang on, they transition into a liquid.
- Now have a small number of students make a liquid. Repeat, but this time, the more heat, the faster they can walk around. How long does it take before they miss making a connection with another molecule? When heat is added to a liquid, the molecules start moving so fast that they start to separate and become a gas.

Fifth Grade

Core Concept: Earth Science: Changes in Landforms and Ocean

It is essential for students to know: Most of the water from precipitation enters into bodies of water. The shape of landforms helps with this process. The Earth has many different bodies of water. Smaller bodies flow (move) into (and help form) larger bodies of water (5.E.3A.1). Both continental and oceanic landforms are similar in their features and formations (5.E.3A.2). The Earth's oceans and land are affected in constructive and destructive ways by natural processes (5.E.3B.1). The movement of ocean water affects land along the shore (5.E.3B.2). Humans can have both harmful and helpful impacts on the Earth (5.E.3B.3).

Most Complex ←		→ **Least Complex**
5.E.3A.2 (a) Identify continental and oceanic landforms based on similar features (e.g., valley and rift, volcano and sea mount, and mountain range and mid ocean ridge).	5.E.3A.2 (b) Match pictures of continental and oceanic landforms based on similar features (e.g., valley and rift, volcano and sea mount, and mountain range and mid-ocean ridge).	5.E.3A.2 (c) Recognize that the ocean floor has similar features to that of landforms on continents.
5.E.3B.1 (a) Use observational data and models to describe natural processes (e.g., weathering, erosion, deposition, earthquakes, hurricanes, and storms) and explain their effect on the Earth's surface.	5.E.3B.1 (b) Match natural processes (e.g., weathering, erosion, deposition, earthquakes, hurricanes, and storms) to their characteristics.	5.E.3B.1 (c) Use pictures to identify natural processes (e.g., weathering, erosion, deposition).
5.E.3B.2 (a) Explain the effect of waves on beaches and naturally occurring barrier islands. Waves can wear away land. They deposit sand along the shore to form a beach and move sand along a coastline. Explain the purpose of barrier islands.	5.E.3B.2 (b) Identify beaches and naturally occurring barrier islands from pictures. Recognize that when waves move ocean water, they change the coastline.	5.E.3B.2 (c) Recognize that waves move ocean water and the ocean meets the land at the shoreline. Recognize that a beach is a sandy shoreline.
5.E.3B.3 (a) Explain what reduce, reuse, and recycle are and their importance, as well as what pollution is and why it is harmful.	5.E.3B.3 (b) Sort activities based on their impact on the earth (good—conservation; bad—pollution).	5.E.3B.3 (c) Identify human activities that help and harm the Earth.

Application of Performance Indicators at the Middle Level—Instructional Activities

5.E.3A.2 (b) Match pictures of continental and oceanic landforms based on similar features (e.g., valley and rift, volcano and sea mount, and mountain range and mid-ocean ridge).

- Materials:
  - Variety of pictures of continental and oceanic landforms (you should be able to pair each continental landform to an oceanic landform)
  - Pictures of continental and oceanic landforms on an interactive whiteboard or student worksheets
- Display a variety of pictures of continental and oceanic landforms. Explain to students that landforms on the continents are similar to those on the ocean floor. Ask students to name some of the landforms they can see on a continent (e.g., valley, volcano, mountain). As students name these landforms, show pictures to illustrate.
- Say that each of these landforms has a similar landform on the ocean floor. Make the first match for them (e.g., valley to rift).
- Ask students to do the next one with you. Then, have students make a match on their own.
- You may incorporate writing in this lesson by having students label the continental and oceanic landforms on a worksheet or on an interactive whiteboard.

Activity adaptation for less complexity

5.E.3A.2 (c) Recognize that the ocean floor has similar features to that of landforms on continents.

- Materials:
  - Picture book or movie clip that illustrates the ocean floor.
  - Materials to create a book comparing oceanic and continental landforms, including:
    - Construction paper
    - Pictures of corresponding oceanic and continental landforms
    - Scissors
    - Glue or other adhesive
- For students who need a little less complexity in the lesson above, have them concentrate on the features on the ocean floor. Perhaps look at a picture book together or show a movie clip of the ocean floor and ask them to point to or tell you the things they see on the ocean floor (e.g., mountains, volcanoes).
- Next, ask them to identify something similar on land (e.g., in the ocean, we see the ocean floor; on the continents, we see land). Do the first one for them so they get the idea of what you're asking.
- As an option, you can create a book with the students to compare the oceanic and continental land forms. For example, one side of the page might be land and the other side ocean. On the land page, write the words, "On land, I see a mountain," with pictures of land and mountain. On the next page, write the words, "In the ocean, I see a mountain" with pictures of the ocean and an underwater mountain. Using simple phrases (e.g., In the ocean, I see…) and pairing pictures with key words can facilitate comprehension for students just beginning to read. Also, pointing to the words as you say them will help students learn that the words you say are the words on the page (concept of word), an important early skill that precedes learning to read. Additionally, allowing the students to publish a book is one way to incorporate writing into your science lesson. Teachers can do an Internet search for *Tar Heel Reader* as an option to publish their book.

Activity adaptation for more complexity

5.E.3A.2 (a) Identify continental and oceanic landforms based on similar features (e.g., valley and rift, volcano and sea mount, and mountain range and mid-ocean ridge).

- Materials:
  - Materials to create dioramas of the ocean floor or the continent
- To extend this lesson, students may take the information learned and use it to create a diorama of the ocean floor or continent that includes several of the same landforms. To further the concept, create land and ocean dioramas. Students can make comparisons of the two. Some students may be able to make presentations to describe the diorama's particular features and how the landform features are similar on the continent and in the ocean.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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.

5.E.3B.2 (a) Explain the effect of waves on beaches and naturally occurring barrier islands: waves can wear away land. They deposit sand along the shore to form a beach and move sand along a coastline. Explain the purpose of barrier islands.

- Materials:
  - Low, flat pans such as rectangular cake pans
  - Enough sand to fill up half of the pan
  - Wide paint brush
  - Science Journals
- Students will observe the effects of waves on a beach.
- Procedure:

  1. Place a mound of sand at one end of the cake pan. Explain to students that the mound represents the sand on the beach.
  2. Measure the height of the mound and have students record the height in their Science Journal.
  3. Fill the other side of the pan with water.
  4. Use the paintbrushes to gently create waves at the end of the pan opposite to the mound. Discuss with students how the waves move along the beach.
  5. Re-measure the height of the mound and have students record the second measurement in their Science Journals. Ask the students what is happening to the sand.
  6. With the paintbrush, demonstrate that once waves go up to the top of the beach, that water doesn't all stay there. If the wave follows gravity, it will finish crashing on the beach and then that same water will roll back down to the ocean. Have students draw this observation in their science journal.
  7. Place a block (or other solid object) in the middle of the water to represent a barrier island and repeat the investigation.

Fifth Grade

Core Concept: Life Science: Interdependent Relationships in Ecosystems

It is essential for students to know: Ecosystems are made up of both living (biotic) and non-living (abiotic) factors. Land and water-based ecosystems are divided according to their characteristics (5.L.4A.1; 5.L.4A.2). All animals need energy to live, grow, and reproduce. In an ecosystem, plants are producers and animals are consumers (5.L.4B.1). Food chains and food webs are used to show how energy is passed through the ecosystem (5.L.4B.2). Organisms can be identified based on how they interact with other organisms (5.L.4B.3). An ecosystem only has a certain amount of resources to support its organisms. Changes in the availability of resources (limiting factors) (e.g., food, water, shelter, space) or the organisms within an ecosystem can impact the ecosystem's population (5.L.4B.4).

Most Complex ←		→ **Least Complex**
5.L.4A.1 (a) Analyze and interpret data to compare the nonliving factors (e.g., quantity of light and water, range of temperature, salinity, and soil composition) of different terrestrial (e.g., forest, wetlands, grasslands) and aquatic (e.g., freshwater such as lakes and ponds, and saltwater such as oceans).	5.L.4A.1 (b) Identify nonliving factors of different terrestrial ecosystems and aquatic ecosystems.	5.L.4A.1 (c) Identify nonliving factors in an ecosystem (e.g., temperature, water, soil, air, sunlight).
5.L.4A.2 (a) Compare the living factors (e.g., organisms, populations, and communities) of different terrestrial ecosystems and aquatic ecosystems.	5.L.4A.2 (b) Identify characteristics of living factors in different terrestrial ecosystems and aquatic ecosystems.	5.L.4A.2 (c) Identify living factors in an ecosystem.
5.L.4B.1 (a) Interpret data to explain how organisms obtain their energy and identify producers, consumers (e.g., plant eaters, meat eaters, both), or decomposers.	5.L.4B.1 (b) Use observational data to classify an organism as a producer, consumer, or decomposer.	5.L.4B.1 (c) Use models or observations to identify organisms as producers or consumers.
5.L.4B.2 (a) Use models of food chains and simple food webs to describe the flow of energy in an ecosystem.	5.L.4B.2 (b) Use models to identify a simple food chain and recognize how organisms obtain energy.	5.L.4B.2 (c) Use pictures to identify an organism's placement in a food chain.
5.L.4B.3 (a) Use data to explain how organisms interact with one another in an ecosystem (e.g., prey-predator, parasite-host).	5.L.4B.3 (b) Use models to identify the roles of organisms in a food chain (predator-prey).	5.L.4B.3 (c) Use pictures to classify organisms into predators or prey.

Most Complex ⟵		⟶ **Least Complex**
5.L.4B.4 (a) Predict and explain the effect of changes limiting factors (e.g., food, water, space, shelter) to an ecosystem's populations (e.g., What will happen to the animals if the grass does not grow? What will happen to the populations of prey if the numbers of predators decrease?).	5.L.4B.4 (b) Use data to describe the effects that limiting factors (e.g., food, water, space, shelter) can have on an ecosystem (e.g., during a drought, the grass will not survive and the number of grass-eating animals will therefore decrease).	5.L.4B.4 (c) Identify limiting factors (e.g., food, water, space, shelter) that affect populations of organisms.

Application of Performance Indicators at the Middle Level—Instructional Activities

5.L.4B.1 (b) Use observational data to classify an organism as a producer, consumer, or decomposer.

- Materials
  - Cards with pictures of organisms (e.g., aquatic plants, algae, insects, small fish, big fish, frogs, snakes, and bacteria) in an aquatic ecosystem
  - Cards with pictures of organisms (e.g., frogs, hermit crabs, snakes, rabbits, mice, owls, birds, worms) in a terrestrial ecosystem
  - Food chain graphic organizer on an interactive whiteboard or chart paper
- Teach the definitions of the following vocabulary words: organism, producer, consumer, and decomposer.
- Introduce the concept of an aquatic ecosystem. Discuss the different organisms (e.g., aquatic plants, algae, insects, small fish, big fish, frogs, snakes, and bacteria) found in a food web in an aquatic ecosystem and list what each organism eats. Use this list to then describe each organism's role (e.g., producers, consumers, and decomposers).
- Distribute cards with pictures of each organism in an aquatic ecosystem to each student and work with the students to separate the cards into the different categories: producers, consumers, and decomposers.
- Using a food chain graphic organizer on an interactive whiteboard or chart paper, work with students to create a food chain that would be found in an aquatic ecosystem by placing a card in each box. Remind students that each food chain must start with a producer, have a consumer, and include a decomposer (e.g., bacteria, worms, fungi).
- Repeat this activity using organisms in a terrestrial ecosystem.

Activity adaptation for less complexity

5.L.4B.1 (c) Use models or observations to identify organisms as producer or consumer.

- For students who need additional support, follow the middle level activity with only producers or consumers.

Activity adaptation for more complexity

5.L.4B.1 (a) Interpret data to explain how organisms obtain their energy and identify producers, consumers (e.g., plant eaters, meat eaters, both), or decomposers.

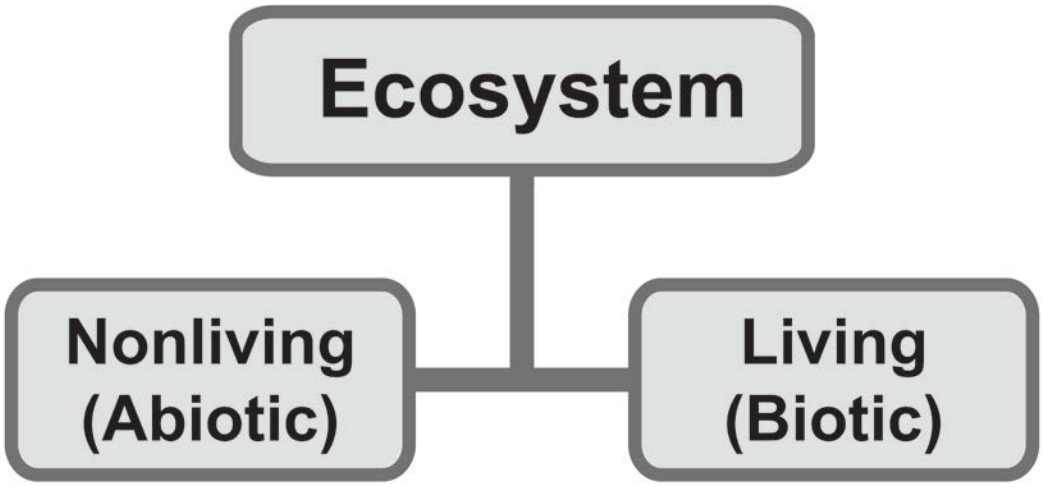
- Materials:
  - Food chain graphic organizer on an interactive whiteboard or chart paper
  - Printed resources on aquatic habitats or Internet access
- For students who have the skills to go further, work with students to create a food web for an aquatic or terrestrial ecosystem.
- After completing the food web, as student the following questions:
  - What would happen to the food web if a specific organism were removed?
  - What would happen to the food web if the population of one of the organisms were to double?
- Provide access to Internet sites or printed resources to allow students to learn more about aquatic habitats and find answers to any questions they may have. Challenge students to create a "Did you know…?" display to share the things they learned about pond life. In addition, students could identify the consumers in the aquatic ecosystem as carnivores, omnivores, or herbivores.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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

5.L.4A.2 (a) Compare the living factors (e.g., organisms, populations, and communities) of different terrestrial ecosystems and aquatic ecosystems.

- Materials:
  - Pictures of ecosystems on an interactive whiteboard or access to an ecosystem
- Show students a variety of ecosystems using an interactive whiteboard or by actually visiting the ecosystem (e.g., a local pond). Review with students what they have learned about ecosystems (e.g., ecosystem has two parts: abiotic [nonliving] organisms and biotic [living] organisms).



- For each ecosystem, complete a T-chart containing the Biotic and Abiotic organisms in each ecosystem.
- Using a Venn diagram, compare the biotic/living organisms of two ecosystems (i.e., pond, forest). Ask students to identify the biotic organisms found in both ecosystems.

Fifth Grade

Core Concept: Physical Science: Forces and Motion

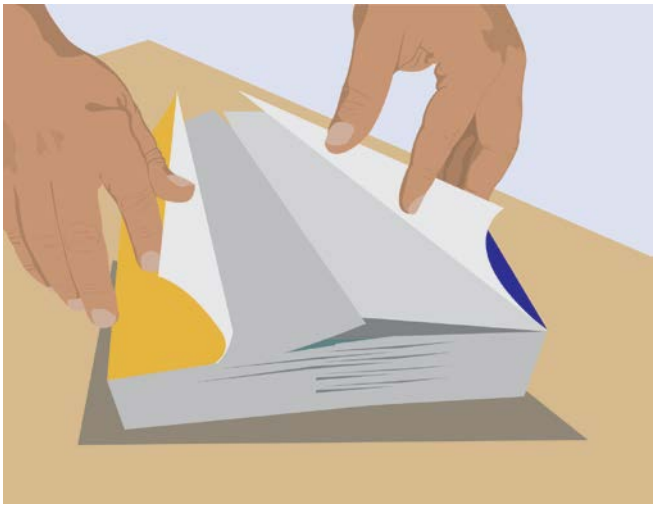
It is essential for students to know: Motion can be described using the terms position, direction, and speed (5.P.5A.1). Forces can make things move faster, slower, stop, or change directions. Different forces can affect motion (5.P.5A.2). A balanced force will not change the motion of an object, but an unbalanced force will change the motion of an object (5.P.5A.3). The motion of an object can be affected by changes in force, mass, or friction (5.P.5A.4). Friction is a force that acts against motion. Friction is affected by texture of the surface, amount of surface area, and lubrication (5.P.5A.5).

Most Complex ←		→ **Least Complex**
5.P.5A.1 (a) Use observations and data to describe and predict the motion of an object in terms of its position, direction, and speed.	5.P.5A.1 (b) Use models to compare the motion of two objects in terms of their position, direction, and speed.	5.P.5A.1 (c) Use models to identify the speed (fast or slow) or direction (up or down) of a moving object.
5.P.5A.2 (a) Use models to explain how the amount or type of force (e.g., gravity, magnetism and friction) affects the motion of an object.	5.P.5A.2 (b) Use models to identify gravity, magnetism, and friction as forces that affect the motion of objects.	5.P.5A.2 (c) Recognize that force can make objects move faster, slower, stop, or change direction.
5.P.5A.3 (a) Investigate the effects (speed up, slow down, change direction) of balanced and unbalanced forces on the rate and direction of motion of objects.	5.P.5A.3 (b) Use models to compare the effects of balanced and unbalanced forces on the rate and direction of motion of an object.	5.P.5A.3 (c) Recognize that unbalanced forces change the rate and direction of motion of an object.
5.P.5A.4 (a) Analyze and interpret data and use models to describe how a change of force, or mass, or friction affects the motion of an object.	5.P.5A.4 (b) Identify the cause of a change in motion (e.g., a ball is rolling faster because it was pushed harder, or a book slides farther when pushed because it is lighter).	5.P.5A.4 (c) Recognize that when the same force (push or pull) is applied to two different objects, the mass (heavy or light) of the objects will affect their motion (e.g., when the same push is applied to a heavier book and to a light book, the heavy book will move less).
5.P.5A.5 (a) Use models to test ways to reduce the effects of friction on the motion of an object.	5.P.5A.5 (b) Illustrate the effect that different surfaces can have on the motion of an object.	5.P.5A.5 (c) Recognize that friction is a force that acts against motion.

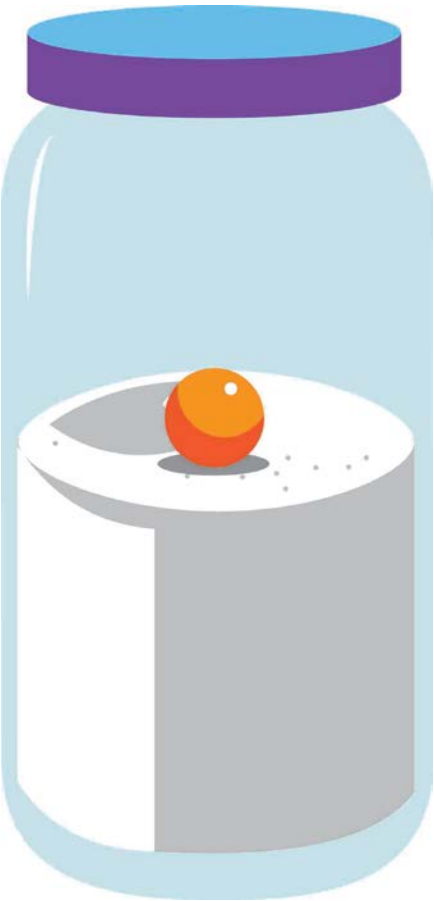
Application of Performance Indicators at the Middle Level—Instructional Activities

5.P.5A.5 (b) Illustrate the effect that different surfaces can have on the motion of an object.

- Materials:
  - Sheep in the Jeep by Nancy Shaw
  - Two large textbooks of similar size
  - Clear, tall jar with a lid
  - Marble or other round object
  - Salt (enough to fill 2/3 of the jar)
- Begin the lesson by reading *Sheep in the Jeep* by Nancy Shaw.
- Discuss what friction is and how it works and relate it to the story.
- Explain that when people hear the word *friction*, they think about things rubbing together, and that's exactly what friction is.
  - Whenever two surfaces rub together, some of the energy they have is lost to friction. This happens everywhere, such as bicycle wheels on pavement or between parts moving in an engine. Friction is a force that slows you down. In order to overcome friction, you have to work harder. However, the energy doesn't just disappear—it's turned into heat! Try rubbing your hands together as fast as you can. They should feel warmer.
  - The rougher two surfaces are, the more friction there is between them when they rub together. Friction can be reduced by making surfaces smoother, which can save energy.
  - Friction isn't always bad, though. If you've ever tried to start running on a wet floor, you know that too little friction can just make you slip and slide. You need a certain amount of friction to get a grip in order to get yourself going. Ever wonder why sneakers always have treads on the bottom? They're there to give you some extra grip when you run and play.
- Take the two large books and randomly overlap large chunks of pages together and try to pull the books apart. Explain to students the pages will easily separate because there is not much friction from the pages slowing you down. However, if you interlace the pages of the books together (like the picture below), it is nearly impossible to separate the two books. That is because of the force of friction on the pages.



- Next, place the marble in the bottom of the jar and fill the jar about 2/3 full with salt. Show the students where the marble is (at the bottom of the jar). Try moving the marble by rolling the jar. The marble won't move much with this motion because friction is slowing it down. Shake the jar up and down and observe the effect on the marble. The shaking motion causes all the particles in the jar to move at the same time, so friction is reduced and the marble can easily move to the top.



<u>Activity adaptation for less complexity</u>

5.P.5A.5 (c) Recognize that friction is a force that acts against motion.

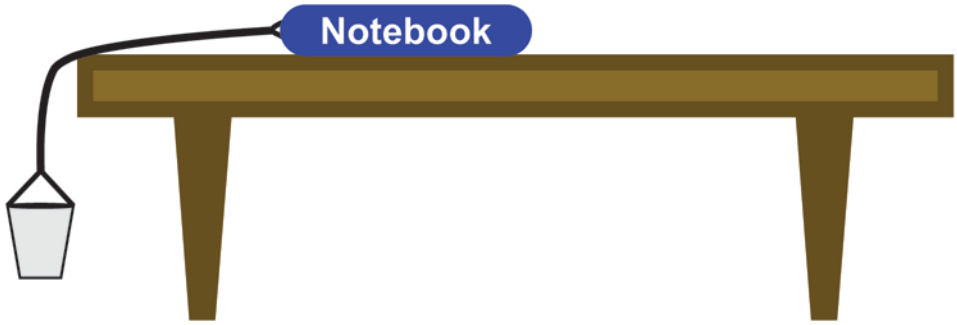
- Materials
  - Sheep in the Jeep by Nancy Shaw
  - One four-legged chair with sliders
  - One four-legged chair without sliders
  - Books or other heavy object
- For students who need additional support, begin the lesson by reading *Sheep in the Jeep* by Nancy Shaw and discuss what friction is and how it works and relate it to the story.
- Demonstrate friction by pushing and pulling a four-legged chair across a floor with and without sliders on the feet. (Having sliders on the feet should make it easier to push or pull the chair.)

- Next, demonstrate how adding books to the seat affects pushing and pulling the chair across a floor. (Having more books should make it difficult to push or pull the chair.) Students who are able may help assist with pushing and pulling the various combinations to further make the connection to the concept.
- Discuss as a class which combination (with or without sliders and with or without books) makes it the easiest to push a chair across the floor according to the students' observations.

<u>Activity adaptation for more complexity</u>

5.P.5A.5 (a) Use models to test ways to reduce the effects of friction on the motion of an object.

- Materials:
  - Large, flat spiral-bound notebook
  - 30-inch string
  - Lightweight plastic cup with holes punched on each side of the top
  - Set of small weights, or washers or marbles of uniform size
  - A large book or plank
  - Masking tape
  - Scissors
  - Glue or tape
  - Regular classroom supplies
- Suggested materials:
  - Felt or other cloth
  - Carpet sample square
  - Fake fur square
  - Rubber bands or rubber gloves
  - Wax paper, parchment paper, linoleum scraps
  - Corrugated cardboard
  - Sandpaper
  - Plastic wrap
  - Cotton balls or quilt batting
  - Weights (could be balance weights or small flat stones or additional washers)
- Before the activity, complete the following:
  - Measure out and cut strings; punch holes in plastic cups near the top. Gather all other materials and put in a central location.
  - Have one notebook prepared: Thread the string through the spiral rings of the notebook; put each end through one hole on either side of the plastic cup. Hang the plastic cup over the edge of a table.



- Students who have the skills to go further will understand the effects of friction and force by completing this activity.
- Draw students' attention to the cup and notebook set up on the table. Ask students what they would need to do to move the notebook across the table. (Pulling down on the cup.) Ask why. (Weights pull the cup down; this force will pull the book across the table.) How could we measure how much force? (Adding weights to the cup one by one until the notebook moves.) Demonstrate this. Write on the board how much weight it takes to move the book to the edge of the table.
- Continue the activity by selecting one of the materials from the list and taping it to the surface of the table (adding friction). Place the notebook with attached cup onto the material. Have the students add weights to the cup and record how much to took to move the notebook to the edge of the table.
- Repeat this step with another material.
- Have the students compare the amount of weight it took to move the notebook on each material. Which material experiences more friction with the book? (The material that results in the most weights required to move the notebook)

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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.

5.P.5A.4 (a) Analyze and interpret data and use models to describe how a change of force, or mass, or friction affects the motion of an object.

- Materials
  - Sheep in the Jeep by Nancy Shaw
  - Three pieces of cardboard (about 1½ feet long by 4 inches wide)
  - Six textbooks or blocks or similar height
  - Aluminum foil (same length and width as the cardboard)

- Sandpaper (same length and width as the cardboard)
- Tape
- Three toy cars (of similar size)
- Ruler
- Chart paper or interactive whiteboard

- Read *Sheep in the Jeep* by Nancy Shaw and discuss examples of friction throughout the story.
- With students, investigate how friction affects motion.
- Procedure

1. Place three strips of cardboard on the floor, next to each other. At the end of each piece of cardboard, place two textbooks or blocks of similar height.
2. Put the end of the cardboard on top of the textbooks to create a ramp and secure the cardboard pieces with tape.
3. Cover one of the cardboard pieces with aluminum foil and another piece of cardboard with sandpaper. (One piece of cardboard will not be covered).
4. Put one toy car on top of each cardboard ramp.
5. Push the first toy car with enough pressure to have the car go down the ramp.
6. Measure the distance that the first car traveled and record the distance on chart paper or on an interactive whiteboard.
7. Repeat steps five and six with the next two cars on the ramp with aluminum foil and sandpaper. Make sure the same of amount of force is applied to each car.
8. Ask students to make observations and record the students' observations.
9. Discuss why there were differences in the distances the cars traveled. For example, why did one car go farther than the other cars? (For each car, there were different amounts of friction applied.)

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Age 11 on or before September 1 (Grade 6)

Sixth Grade

Core Concept: Earth Science: Earth's Weather and Climate

It is essential for students to know: The water cycle is the process of water moving between the atmosphere, land, and oceans. The phases of this cycle are aided by gravity and sunlight (6.E.2A.3). Weather predictions are made based on analyzing and interpreting data from observations and a variety of tools (6.E.2B.1). Climate in regions is affected by many factors (6.E.2B.4). Thunderstorms, hurricanes, and tornados are caused by air changes in a climate (6.E.2B.2).

Most Complex ←		→ **Least Complex**
6.E.2A.3 (a) Use models to explain the processes involved in the cycling of water through the Earth's system.	6.E.2A.3 (b) Use illustrations to describe the processes of the water cycle.	6.E.2A.3 (c) Use pictures to identify condensation, evaporation, and precipitation (rain or snow).
6.E.2B.1 (a) Analyze and interpret data from weather conditions and simplified weather maps to predict local weather patterns and conditions.	6.E.2B.1 (b) Use observational data to identify and describe weather conditions to predict local weather patterns.	6.E.2B.1 (c) Use observations and pictures to identify local weather conditions and patterns.
6.E.2B.2 (a) Predict storms that might come, given certain conditions.	6.E.2B.2 (b) Identify characteristics of different types of storms (e.g., Why is that a tornado and not a hurricane?).	6.E.2B.2 (c) Use pictures or simple models to identify thunderstorms, hurricanes, and tornadoes
6.E.2B.4 (a) Interpret data and use models to explain how the climate is determined in an area (e.g., latitude, elevation, shape of land, distance from water, global winds).	6.E.2B.4 (b) Describe how the climate is determined in an area based on location, shape of land, and distance from water.	6.E.2B.4 (c) Match climate to an area or region.

Application of Performance Indicators at the Middle Level – Instructional Activities

6.E.2B.2(b) Identify characteristics of different types of storms (e.g., Why is that a tornado and not a hurricane?).

- Select the number and types of storms you will discuss with your class. You want to select the types of storms that likely occur in your region. This lesson includes teaching the characteristics of a storm, as well as creating a poster illustrating these characteristics. The procedures can be repeated for other types of storms, and the posters created can be displayed on a classroom wall or hallway.
- This lesson is developed around teaching the characteristics of a thunderstorm. Before the lesson, collect pictures of the different characteristics of a thunderstorm (e.g., strong winds, rain, hail, lightning, thunder). One by one, show students the pictures as you describe the characteristics. For students with hearing impairments, play sounds of the pictures you are describing (e.g., the sound of rain for a picture of rain, the sound of thunder with a picture of thunder). For students with visual impairments, engage their other senses (i.e., hearing, feeling, or touch) during discussion of the characteristics of a thunderstorm (e.g., spray water on their arm for rain and use a fan for wind).

- On a poster-sized piece of paper, write the word “thunderstorm.” As you talk about the characteristics of this type of storm, ask students to paste the pictures on the poster. When the poster is complete, have several students review the characteristics of a thunderstorm for the class by pointing to the pictures on the poster and describing the characteristics.

Activity adaptation for less complexity

6.E.2B.2 (c) Use pictures or simple models to identify thunderstorms, hurricanes, and tornadoes.

- For students who need more support, simplify the learning expectation to identifying two or three types of storms (rather than the characteristics of each). After the posters are completed in the lesson above, have students match a picture of a particular storm to its poster (e.g., a picture of a thunderstorm to the thunderstorm poster). This could complete the poster if the picture is not paired with the word for the poster in the lesson above. In that case, the student could place the picture with the word “thunderstorm” to complete the poster. For students with sensory impairments, use water in a bottle for tornado, water sprayed from a spray bottle for rain, and a fan for wind.
- For AAC users, record the sound of storms on the AAC device. Use water in a bottle to demonstrate rain or a fan to demonstrate wind.

Activity adaptation for more complexity

6.E.2B.2 (a) Predict storms that might come given certain conditions.

- For students who have the skills to go further, the lesson above can be extended by giving the student the conditions of a storm and having them identify the storm. Students can use the posters displayed in the classroom for reference. Students can complete a chart in their Science Journal that lists the storm characteristics on one side of the paper. The student should then list the type of storm that the characteristics describe. This can be done by writing the name of the storm or through the use of word or picture cards. For students writing a word, a word bank should be provided.

Conditions	Type of storm
strong wings, rain, hail, lightning, thunder	Thunderstorm
Word Bank: Thunderstorm Tornado Hurricane	

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

6.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, 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.

6.E.2A.3 (a) Use models to explain the processes involved in the cycling of water through the Earth's system.

- Experiment/Investigation: Students will investigate the role that temperature has in evaporation and condensation.
- Materials:
  - Each group has:
    - 2 plastic solo cups (not Styrofoam)
    - Paper towels to set cups on
  - The teacher has:
    - Warm water
    - Ice water
- Review the water cycle with students. How does water get from the ocean to the clouds? How does it get back to Earth?
- Ask the question: What does temperature have to do with the water cycle?
- Explain that you're going to make a model of the water cycle to investigate the role of temperature in the water cycle. In this model, the cups of water represent air temperature. One cup represents cold air and the other cup represents warm air.

- Tell students they are going to test which temperature of water makes it “rain first.” Rain happens when drops of water accumulate on the outside of the cup.
  - Fill one cup with ice water and one with warm water.
- Together, make predictions using the table below:

	Rain First?
Cold Water	
Warm Water	

- After five to ten minutes (as long as condensation has formed on the outside of the ice water cup), have the students observe the cups.
- What does temperature have to do with evaporation and condensation? Why did the combination that “rained first” work best? (Answer: When warm, moist air cools, it makes water drops.)

Writing idea:

Have students complete the concept statement, “When warm moist air cools, it makes _____.” Students can complete the statement by writing words, pasting a picture, using an object that represents water drops, or activating a switch.

Sixth Grade

Core Concept: Physical Science: Energy Transfer and Conservation

It is essential for students to know: There are many forms of energy, including mechanical, electrical, chemical, radiant, and thermal (6.P.3A.1). Energy is transferred and transformed in electrical circuits. An electrical circuit must be an unbroken path through which electricity flows. (6.P.3A.3). Energy can also be transferred through the use of simple machines (6.P.3B.1). How a simple machine is used determines how much energy must be exerted to complete an action (6.P.3B.2).

Most Complex ⟷		**Least Complex**
6.P.3A.1 (a) Describe the properties and sources of energy (e.g., heat—rubbing things together, solar—the sun, and electrical—circuits).	6.P.3A.1 (b) Identify the sources of heat, solar, and electrical energy.	6.P.3A.1 (c) Match a type of energy (heat, solar, and electrical) with its source (fire, sun, and battery).
6.P.3A.3 (a) Explain how energy is conserved and transformed.	6.P.3A.3 (b) Demonstrate the transformation of energy in a circuit, light bulbs, motors.	6.P.3A.3 (c) Identify a complete circuit.
6.P.3A.5 (a) Use models to describe and compare the transfer of heat through the process of conduction through objects that are conductors compared to objects that are insulators (convection, radiation, and conduction).	6.P.3A.5 (b) Investigate and use models to identify heat transfer by conduction (e.g., hot water and a metal spoon, a heating pad and a towel, examples where no heat transfer occurs, radiation and convection).	6.P.3A.5 (c) Investigate to identify conduction has occurred from one object to another (e.g., feel a metal spoon, dip spoon in hot water, feel spoon again; consider whether the spoon feels the same or different, hotter or colder).
6.P.3B.1 (a) Investigate and use models to describe how the design of simple machines (e.g., levers, pulleys, inclined planes) helps transfer energy by reducing the amount of force required to do work.	6.P.3B.1 (b) Use models to match a simple machine (e.g., levers, pulleys, inclined planes) to its task.	6.P.3B.1 (c) Use pictures of actual objects or photographs to identify a simple machine (e.g., levers, pulleys, inclined planes).
6.P.3B.2 (a) Develop and use models to describe and compare the directional transfer of heat through convection (rice boiling), radiation, and conduction (touch).	6.P.3B.2 (b) Use models or illustrations to identify which simple machine required more force to move an object.	6.P.3B.2 (c) Use models or pictures to identify the difference between two simple machines.

Application of Performance Indicators at the Middle Level—Instructional Activities

6.P.3A.1 (b) Identify the sources of heat, solar, and electrical energy.

- Students will identify sources of electrical energy.
- Explain to the students that electricity results when one energy changes to another. There are many different sources of electricity. Each of them requires a device to collect and transform energy.
- Present an image of each of the following devices to the students, and ask them to identify the source of energy required for them to produce electricity:
  - A solar panel: What is the source of energy solar panels use to produce electricity? (sunlight)
  - A wind turbine: When wind turbines spin, this mechanical energy is transformed into electricity. What is the source of this mechanical energy? (the kinetic energy of wind)
  - A dam: As water moves through the dam, it turns turbines. This mechanical energy is transformed into electricity. What is the source of the mechanical energy in a dam? (The potential energy of water behind a dam converting to kinetic energy.)

Activity adaptation for less complexity

6.P.3A.1 (c) Match a type of energy with its source.

- For students who need more support, simplify the learning expectations in the lesson above. The learning expectation for this student would be to match a type of energy with its source. To accomplish this, create a set of cards for matching. One card will have a picture of a form of energy (e.g., light, sound, heat), and the other will have a picture of a source for that energy. For example, one type of energy is heat, and a source of that energy is the sun. Show students the heat card and ask, "Where does heat come from?" For each question, present three response options (one correct and two distractors).

Activity adaptation for more complexity

6.P.3A.1 (a) Describe the properties and sources of energy (e.g., heat: rubbing things together, solar: the sun, chemical: batteries, electrical: circuits, or mechanical: a fan).

- For students who have the skills to go further, the lesson above can be extended by asking them to research different energy sources and complete a table with the information they find. The table should include sources of energy, its availability, advantages (good things) and disadvantages (bad things) of its use, and a way that energy gets used in life. Some possible sources of energy to include in the table are: solar, wind, wave, geothermal, hydropower, tides, coal, oil, natural gas.

Writing idea: Have students complete the sentence using words, pictures, object representations, or by activating a switch.

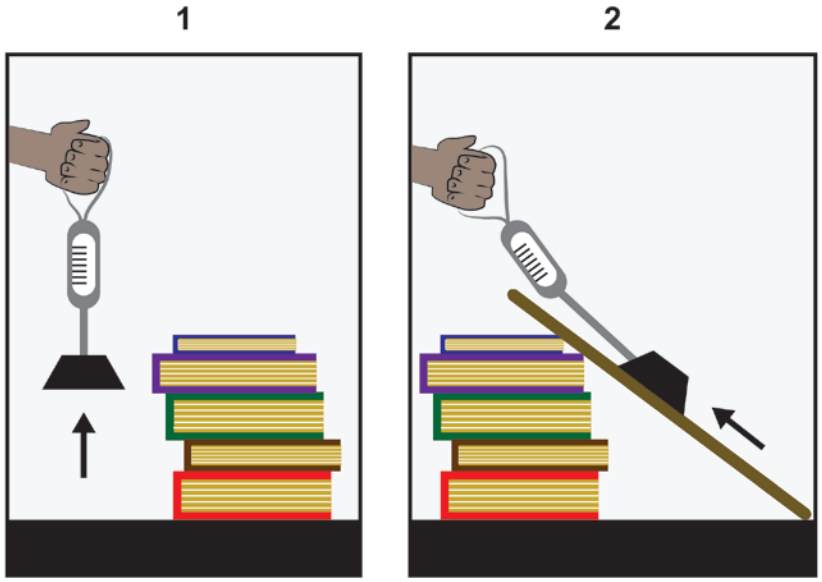
"Some sources of energy are: _____."

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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

6.P.3B.1 (a) Investigate and use models to describe how the design of simple machines (e.g., levers, pulleys, inclined planes) helps transfer energy by reducing the amount of force required to do work.

- Show how the steepness of an inclined plane can affect the amount of force necessary to do work.
  - Materials:
    - One stack of hardback books, approximately twelve to sixteen inches high
    - Yardstick or board
    - Spring scale
    - Weights
  - Procedure:
    - Make a stack of books about twelve to sixteen inches high.
    - Use the spring scale to lift a weight to the top of the stack of books from the ground. Measure and record the results.
    - Form a ramp by leaning a yardstick or board against the top of the book stack.
    - Pull the same weight up the yardstick with a spring scale. A diagram is shown below.
    - Measure and record the results.



  - Discussion: The weight ended up on top of the books both times. We did the same work for both, but which way is easier (i.e., less work). Look at the results you recorded from the experiment. Which way used less force?

Experiment	Spring scale measurement
Lifting weight from ground to top of books	
Dragging weight up ramp to top of books	

Writing idea: Have students use words, pictures, object representations, or switches to complete the concept statement.

“Simple machines make work <u>easier</u>.”

Sixth Grade

Core Concept: Life Science: Diversity of Life—Classification and Animals

It is essential for students to know: All living organisms obtain and use resources for energy, respond to stimuli, reproduce, and grow and develop (6.L.4A.1). Organisms can be classified according to their structure (6.L.4A.2). Animals are divided into two groups, vertebrates and invertebrates, based on internal and external physical characteristics (6.L.4B.1). Animals have special structures that allow them to survive in their environments. These structures allow them to defend themselves, to move, and to obtain resources (6.L.4B.2). Animals respond to environmental stimuli through a variety of behaviors, including hibernation, migration, and defensive behavior (6.L.4B.3).

Most Complex ←		→ **Least Complex**
6.L.4A.1 (a) Explain the characteristics and processes that all organisms share (e.g., responding to stimuli, reproducing, using food for energy, growing, and developing).	6.L.4A.1 (b) Summarize characteristics of all living organisms (e.g. they respond to stimuli, they obtain food for energy).	6.L.4A.1 (c) Identify how organisms grow and develop (e.g., air for breathing, food for growth).
6.L.4A.2 (a) Identify and classify common species in the plant and animal kingdoms.	6.L.4A.2 (b) Classify organisms of the same species (e.g., all dogs together, all cats together).	6.L.4A.2 (c) Identify organisms as either plants or animals.
6.L.4B.1 (a) Compare/contrast characteristics of vertebrate and invertebrate groups.	6.L.4B.1 (b) Classify animals as vertebrates and invertebrates on the basis of their characteristic structures.	6.L.4B.1 (c) Sort pictures of organisms.
6.L.4B.2 (a) Use models and observations to classify the structures of animals on the basis of their functions (e.g., feet and legs for movement, claws and horns for defense).	6.L.4B.2 (b) Match the structures of animals with their function (e.g., legs and muscles for movement, teeth and beaks for obtaining resources).	6.L.4B.2 (c) Use pictures to identify the structures of animals that allow them to move (e.g., legs, wings) or to obtain resources (e.g., beaks, teeth, pincers, claws).
6.L.4B.3 (a) Classify the behavioral responses of animals (e.g., hibernation, migration, defensive behavior) to environmental stimuli (e.g., cold temperatures, lack of food, threats from other animals).	6.L.4B.3 (b) Match a behavioral response to environmental stimuli (e.g., bear hibernating in winter).	6.L.4B.3 (c) Identify an animal's behavioral response to environmental changes.

Application of Performance Indicators at the Middle Level—Instructional Activities

6.L.4A.2 (b) Classify organisms of the same species (e.g., all dogs together, all cats together).

- To introduce the idea that one way to classify organisms is by species, collect a variety of pictures of different species of animals (e.g., dogs, cats, rabbits, mice).
- Together, identify features of the animals such as having a snout, a long, thin tail, short nose, strong hind legs, relatively small body sizes, pointed ears, etc.
- Then ask students to sort by species (e.g., all dogs together, all cats together, all rabbits together, all mice together).

Activity adaptation for less complexity

6.L.4A.2 (c) Identify organisms as either plants or animals.

- For students who need more support in the above activity, simplify the learning expectation to identifying organisms as either plants or animals. Some students may benefit from teaching the concepts separately using direct instruction and examples and non-examples. Here's an example of what the teacher would say when using examples and non-examples: This is a plant (point to picture of a tree); This is a plant (point to picture of a flower); This is a plant (point to picture of grass); This is not a plant (point to picture of a person); This is not a plant (point to picture of an animal such as a rabbit).
- To assess whether students have learned the concept, place three or four pictures in front of students (one plant and two or three distractors) and ask them to point to the plant. If correct, move to next session. If incorrect point to correct pictures and say, "This is the plant." Once the student has learned the concept of plant, then repeat the direct instruction procedures for animals.
- For students with sensory impairments, use objects, sounds, or smells with pictures.

Activity adaptation for more complexity

6.L.4B.1 (a) Compare/contrast characteristics of vertebrate and invertebrate groups.

- For students who have the skills to go further with the lesson above, ask them to use a Venn diagram to compare and contrast the characteristics of vertebrate and invertebrate animals. Students can select two animals to compare and contrast (e.g., mammals, birds, reptiles, amphibians, fish, and invertebrates).
- Some of the characteristics to compare include how they breathe, whether they have a backbone, what covers them, how they reproduce, and whether they are warm-blooded or cold-blooded. Students could complete a table with this information before comparing the animals with a Venn diagram.

Writing idea:

Have students complete the statements using words, pictures, object representations, or switches.

"Vertebrates have _____."

"Invertebrates have _____."

"Both vertebrates and invertebrates have _____."

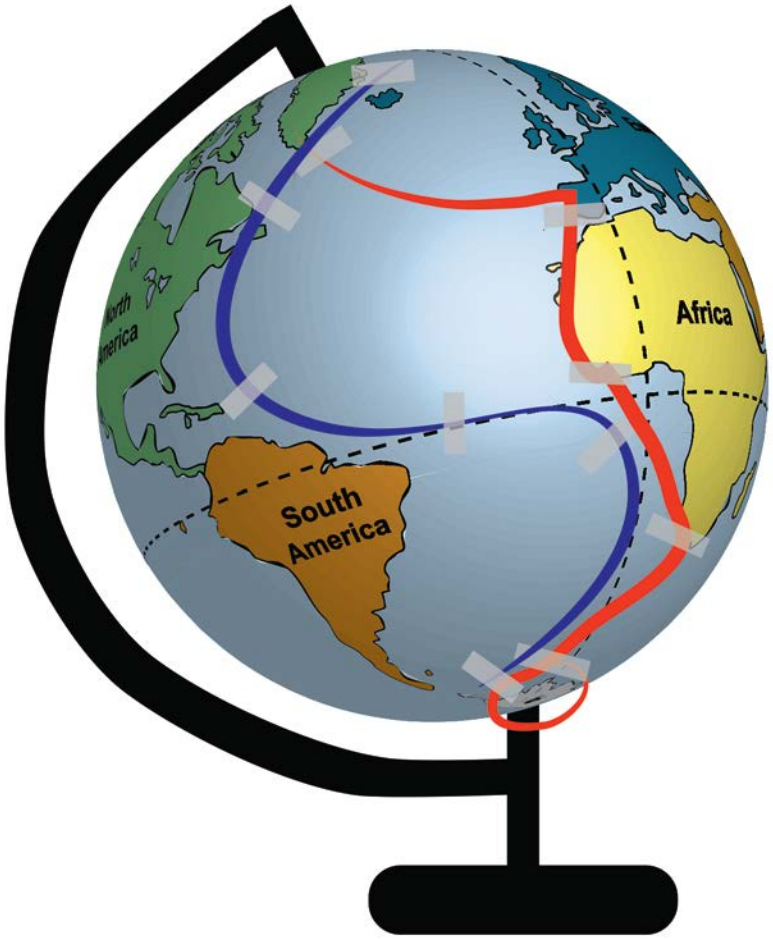
Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

6.S.1A.6 Construct explanations of phenomena using (1) primary or secondary 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.

6.L.4B.3 (a) Classify the behavioral responses of animals (e.g., hibernation, migration, defensive behavior) to environmental stimuli (e.g., cold temperatures, lack of food, threats from other animals).

- Model the migration of the Arctic tern.
- Materials:
  - Pictures, including a picture of an Arctic tern
  - Map
  - Globe
  - String (approximately twenty inches, depending on the size of your globe)
  - Masking tape
  - Scissors
- Procedure:
  - Show students a picture of the Arctic tern. Then locate Greenland on the globe. "This is where baby terns hatch in late June or July." Place a piece of masking tape here.
  - "Within a few weeks, the terns are ready to begin their migration. They will migrate all the way to Antarctica. By the time they get to Antarctica, it will be summer there." Use the globe, a twenty-inch piece of string, and a piece of masking tape to mark their journey.
  - "After leaving Greenland, they fly to the west coast of Europe." Stretch your string and tape it from Greenland to the west coast of France, Spain, or Portugal.
  - "From this point, they fly down the west coast of Africa." Stretch your string and tape it to at least two points near the top and bottom of Africa's west coast.
  - "From a point near the southwest part of Africa, they make a long journey over the south Atlantic and the Antarctic Ocean to the crusted ice of Antarctica." Stretch your string across the oceans to Antarctica and tape it there. "Because the seasons are opposite in the Northern and Southern Hemispheres of our Earth, it is summer in the south when it is winter in the north."
  - "Terns spend several months in Antarctica, during which time they may circle the entire continent." Make a circle with your string around Antarctica.

– “Look at the string path from Greenland to Antarctica on your globe. This marks half the distance a tern flies each year. By May, winter is beginning in Antarctica and the tern returns to Greenland by a slightly different route.” You may mark or cut the string where the tern’s journey ends in Antarctica. You may also choose to demonstrate the terns flying back to Greenland by tracing the path with the remaining string. Your globe may look like this:



– Discussion: The question posed in this experiment was - How far does the Arctic tern travel? Use the yarn to show students how far the bird traveled. To illustrate how far the distance is, wrap the yarn around the globe. Every time you wrap the yarn around the equator, the distance is 24,860 miles.

Sixth Grade

Core Concept: Life Science: Diversity of Life—Protists, Fungi, and Plants

It is essential for students to know: Plants can also be classified into two major groups, vascular and nonvascular, based on their internal structures (6.L.5B.1). Plants must perform the processes of photosynthesis and respiration in order to survive (6.L.5B.2). Flowering plants use different structural adaptations for survival, defense, and reproduction (6.L.5B.3). Plants need certain amounts of resources to survive and grow. Too much or too little of a needed resource can affect a plant's life cycle (6.L.5B.4). Plants respond to changes in their environments. These responses vary depending on the specific environmental stimulus (6.L.5B.5).

Most Complex ←		→ **Least Complex**
6.L.5B.1 (a) Classify plants into two groups (vascular and nonvascular) based on the internal structures used to transport food and water.	6.L.5B.1 (b) Use models to describe how plants use internal structures to transport food and water.	6.L.5B.1 (c) Identify the structures of a plant (e.g., roots, stems and leaves) that transport food and water.
6.L.5B.2 (a) Interpret a model of the processes of photosynthesis and respiration (getting energy for growth), which are necessary for plant survival.	6.L.5B.2 (b) Identify the components of photosynthesis: light (sun or artificial), water, and air (for carbon dioxide), which are necessary for plant survival.	6.L.5B.2 (c) Recognize that light and water are necessary for green plants' survival to make food (photosynthesis).
6.L.5B.3 (a) Identify the structural adaptations and processes that flowering plants use for defense (thorns), survival (the stem supports the plant and also transports water from the roots to the leaves), and reproduction (seeds).	6.L.5B.3 (b) Use models or illustrations to match the structures of a plant and their functions (e.g., leaves make food, stems provide support).	6.L.5B.3 (c) Identify the structures of plants (e.g., roots, leaves).
6.L.5B.4 (a) Predict how air, water, light, minerals, and space affect the growth and development of flowering plants.	6.L.5B.4 (b) Investigate to describe how air, water, light, minerals, and space affect the growth and development of flowering plants.	6.L.5B.4 (c) Identify that all flowering plants need air, water, light, minerals, and space.
6.L.5B.5 (a) Interpret data to summarize ways that plants respond to the factors in their environment (e.g., temperature, light, water, gravity).	6.L.5B.5 (b) Use observational data and models to recognize that plants grow toward light, roots grow down, and stems grow up.	6.L.5B.5 (c) Use pictures to recognize that plants grow towards the light.

Application of Performance Indicators at the Middle Level—Instructional Activities

6.L.5B.1 (b) Use models to describe how plants use internal structures to transport food and water.

- Use a diagram or model of a nonvascular plant (e.g., moss) and a vascular plant (e.g., tree) to introduce the internal structures that are used by plants to transport food and water.
  - Nonvascular plants do not have special tissues for moving water, minerals, and food through the plant. They grow close to the ground to be near their water source.
  - Vascular plants have special tissues that move water, minerals, and food through the plant. The vascular plants can grow tall because tubes in the stems carry water throughout the plant.
- To assess students' understanding, ask them to complete the following fill-in-the-blanks. Pictures should be used with the questions to illustrate and support comprehension.
- Take a trip outside to observe various plants. The questions below can be completed in the classroom or outside.

1. Plants like this never grow tall because they don't have a system of vessels to carry water around the plants. (nonvascular)
2. The tree is a _____ plant. (vascular)
3. Green algae are considered this kind of plant. (nonvascular)
4. This is an enlarged picture of a liverwort. It's only about one inch in height. The liverwort is a _____ plant. (nonvascular)
5. Vascular plants can grow very tall because tubes in their stems carry water throughout the plant. Trees are _____ plants. (vascular)
6. _____ plants do not have a system of tubes to carry water through them. (Nonvascular)
7. Nonvascular plants usually grow near _____ or in moist areas because they don't have deep roots. (water)
8. The veins in this leaf indicate it is from a _____ plant. (vascular)
9. One way scientists classify plants is vascular plants versus nonvascular plants. Vascular plants have _____ that carry water and nutrients through the plant. (tubes)
10. Flowering plants are _____. (vascular)
11. The tomato plant is a _____ plant. (vascular)
12. The moss shown here growing on a roof is a _____ plant. (nonvascular)
13. In the stem cross-section, you can see the vessels that transport water through the plants. The stem is from a _____ plant. (vascular)

Activity adaptation for less complexity

6.L.5B.1 (c) Identify the structures of a plant (e.g., roots, stems, and leaves) that transport food and water.

- For students who need additional support, use diagrams and/or actual plants to help identify the roots, stems, and leaves of various plants. Tell students that these structures help the plant carry food and water so the plant can grow. The roots get water from the soil, and the stem carries the water up the plant to the leaves. The leaves use the water to make food for the plant. Have the students trace their finger on the path taken by the food and water.

Activity adaptation for more complexity

6.L.5B.1 (a) Classify plants into two groups (vascular and nonvascular) based on the internal structures used to transport food and water.

- For students who have the skills to go further, they can complete a Venn diagram that describes the differences between vascular and nonvascular plants.
- Vascular plants:
  - Have a stem of tubes that carry water
  - Grow taller
  - Have leaves, roots, stems
  - Some have flowers and some have cones
  - Example: Rosebush
- Nonvascular plants:
  - Simplest types of plants
  - Grow close to the ground
  - Don't have leaves, roots, stems
  - Example: mosses
- Both vascular and nonvascular plants:
  - Need water to survive
  - Are living things
  - Use the sun to make their own food

Writing idea:

Have students complete the following statements using words, pictures, object representations, or switches.

"Vascular plants _____."

"Nonvascular plants _____."

"Both vascular plants and nonvascular plants _____."

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

6.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, 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.

6.L.5B.2 (b) Identify the components of photosynthesis: light (sun or artificial), water, and air (for carbon dioxide) are necessary for plant survival.

- Experiment/Investigation: Photosynthesis and oxygen
- Materials:
  - Leaves from broad leaf plant
  - Bowl of water for each group
  - A sunny place
- Procedure:

  To begin, students should remove a single leaf from a broad-leaved plant and place the leaf in a clear bowl of water set in a sunny spot. After an hour, students can return to the bowl and observe the area around the leaf. They should notice small bubbles, the oxygen released from the leaf through photosynthesis. Students can conduct the same experiment in a dark location and compare the results.

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Age 12 on or before September 1 (Grade 7)

Seventh Grade

Core Concept: Physical Science: Classification and Conservation of Matter

It is essential for students to know: Matter can be a pure substance such as an element or single compound or it can be a mixture with parts that are easy to distinguish or more uniform in composition (7.P.2A.3). Physical and chemical properties can be used to classify substances. A physical property can be observed and measured without changing the kind of matter being studied. A chemical property can be recognized only when substances do or do not react chemically with one another (7.P.2B.1). Physical and chemical properties affect substances in different ways. A physical property does not change the composition of a substance. A chemical property results in the formation of one or more new substances with new physical and chemical properties (7.P.2B.4).

Most Complex ⟵		⟶ **Least Complex**
7.P.2A.3 (a) Distinguish between heterogeneous mixtures (e.g., pizza, tossed lettuce salad, trail mix) and homogenous mixtures (e.g., lemonade with sugar dissolved, air).	7.P.2A.3 (b) Classify/Identify ingredients and mixtures.	7.P.2A.3 (c) Identify a mixture.
7.P.2B.1 (a) Analyze and interpret data to compare two substances using physical properties and chemical properties.	7.P.2B.1 (b) Use observational data to compare physical and chemical properties.	7.P.2B.1 (c) Use observational information to identify a physical property of a substance (e.g., color, hardness, magnetic property).
7.P.2B.4 (a) Explain how physical and chemical changes affect the properties of a substance.	7.P.2B.4 (b) Use observational data to describe a physical change of a substance.	7.P.2B.4 (c) Use models and pictures to identify a physical change (e.g., ice melting, paper torn into smaller pieces).

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

7.P.2A.3 (b) Classify/Identify ingredients and mixtures.

- An ingredient is one type of building block or piece that helps to form a mixture. A mixture is made of more than one ingredient. In some mixtures, you can observe the individual ingredients. You can also sort the individual ingredients out of a mixture. We are going to investigate some substances and decide whether they are ingredients or mixtures.
- Give students examples of both and have them classify each based on the definitions above. Some examples include:

  Ingredients

  – Sugar
  – Dry rice
  – Salt

- Dry beans
- Raisins
- Cheerios

Mixtures

- Trail mix
- Rice & beans
- Fruit Salad
- A bowl with different types of candy in it
- A bowl of mixed coins

- To extend the activity further, have students practice making their own mixture by combining different ingredients. (Note: students should avoid mixing salt and sugar together as it will be difficult for them to observe this as a mixture without the use of a microscope.) Students can also practice separating a mixture into its individual ingredients. During this extension, provide the students the opportunity to use scientific tools, such as a pan, magnifying glass, and other tools depending on the mixture to aid them in separating the mixture.

<u>Activity adaptation for less complexity</u>

7.P.2A.3 (c) Identify a mixture.

- For students who need additional support, simplify the learning expectation from the lesson above to solely identifying a mixture. A mixture is a substance made by mixing other substances together. You can observe the pieces of a mixture.
- Show the student some common mixtures in the classroom. Then make some mixtures that the student would enjoy (milk and cereal, cookies in ice cream, trail mix, salad).

<u>Activity adaptation for more complexity</u>

7.P.2A.3 (a) Distinguish between heterogeneous mixtures (e.g., pizza, tossed lettuce salad, trail mix) and homogenous mixtures (e.g., lemonade with sugar dissolved, air).

- Students who have the skills to go further can classify mixtures into homogeneous and heterogeneous mixtures. The difference between heterogeneous and homogeneous mixtures is the degree to which the materials are mixed together and the uniformity of their composition.
  A homogeneous mixture is a mixture where the components that make up the mixture are uniformly distributed throughout the mixture, and the composition of the mixture is the same throughout. Examples of homogeneous mixtures include air, sugar water, vinegar, dishwashing detergent. You can't pick out components of a homogeneous mixture or separate them easily.
- A heterogeneous mixture is a mixture where the components of the mixture are not uniform throughout. Different parts of the mixture are not identical to each other. Heterogeneous mixture examples include cereal in milk, vegetable soup, pizza, gravel, ice in soda, soil. Usually, it's possible to physically separate components of a heterogeneous mixture. For example, you can remove ice cubes from soda, and you can separate candies according to color.

- Ask students to separate the examples in this activity into homogeneous and heterogeneous mixtures. Remember, heterogeneous mixtures can be easily separated. For example, students can easily separate the ingredients in trail mix.

Writing idea:

Have students complete the statement using words, pictures, object representations, or switches.

"A mixture that can be easily separated is _____."

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

7.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs, or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

7.P.2B.1 (b) Use observational data to compare physical and chemical properties.

- Every student begins with a piece of paper. Explain that together you are going to make a change to the piece of paper. Instruct the students to fold the piece of paper. You may take the paper folding a step further by making paper airplanes or a simple origami activity, such as a flower.
- Ask the students if the paper changed. Then ask the students if you can undo the change. Because you can undo the change to the paper, that is a sign that this is a physical change. If you tear the piece of paper, you may not be able to undo it, but it is still paper. Students should record this observation in their Science Journals.
- Then carefully demonstrate to the students burning the piece of paper. Ask the students if the paper changed. What was produced from the change? (smoke and ashes) Can you undo the change? (no) Because you cannot turn the ashes and smoke back into paper, this was a chemical change. Students should record this observation in their Science Journals.
- Over the course of the next few weeks, have students write down whether they believe the following changes will be physical or chemical. Then demonstrate the changes, and have them record their conclusions.
  - Mold shapes using modeling material—students will observe that the shapes can be changed back to their original form, so this must be a physical change.
  - Freeze a carton of milk—students will observe that you can thaw frozen milk, and it will still be milk, so freezing and melting must be a physical change.
  - Mix vinegar and baking soda—students will observe bubbles and gas forming, so there must be a chemical reaction. This is a chemical change to the vinegar and baking soda.
  - Boil water—students will observe that steam from boiling water can condense into liquid water again, so boiling and condensation are physical changes.
  - Mix a fruit salad—students will observe that the fruit does not react with other pieces of fruit, and the parts of this mixture can be separated easily again. Mixing fruit together is a physical change.

- Bake cookies—students will observe that the ingredients react together and cannot be separated, so this must be a chemical change.

Writing idea:

Have student complete the underlined portions of the statement below using words, pictures, object representations, or switches. For example:

"When I mixed fruit to make fruit salad, there was a <u>physical change</u> because <u>we can easily separate the individual parts</u>."

Seventh Grade

Core Concept: Life Science: Organization in Living Systems

It is essential for students to know: Organisms are made of at least one cell. These cells are the most basic structure and function of organisms. Cells can only come from existing cells (7.L.3A.1). Cells are classified based on unique characteristics (7.L.3A.2). Plant and animal cells have unique structures. Plants have a cell wall and contain chloroplasts, which animal cells do not (7.L.3A.3). Cells are also present in organisms known as bacteria. Bacteria can be both helpful and harmful to organisms and the environment (7.L.3A.4). Cells within a multicellular organisms are grouped to perform specific functions within the organism. These can be grouped into cells, tissues, organs, and systems (7.L.3B.1). These groupings work together to perform all of the functions an organism needs to survive (7.L.3B.2).

Most Complex ←		→ **Least Complex**
7.L.3A.1 (a) Recognize that (1) organisms are made of one or more cells, (2) cells are the basic unit of structure and function of organisms, and (3) cells come only from existing cells.	7.L.3A.1 (b) Recognize that (1) organisms are made of one or more cells, and (2) cells are the basic unit of structure and function of organisms.	7.L.3A.1 (c) Using examples, identify living and nonliving matter.
7.L.3A.2 (a) Compare basic structures of plant and animal cells (similarities and differences).	7.L.3A.2 (b) Classify cells as either plant or animal cells.	7.L.3A.2 (c) Use pictures to identify the shapes of animal cells (round) and plant cells (rectangular).
7.L.3A.3 (a) Use models to identify functions of different parts of a cell (e.g., cell wall, nucleus, cell membrane, vacuoles).	7.L.3A.3 (b) Identify parts of a plant cell (e.g., nucleus, cell membrane, cell wall, vacuoles) and animal cell.	7.L.3A.3 (c) Identify parts of the plant cell (nucleus and cell wall).
7.L.3A.4 (a) Explain how bacteria is both helpful and harmful.	7.L.3A.4 (b) Classify effects of bacteria as helpful or harmful.	7.L.3A.4 (c) Identify a helpful (e.g., cheese, yogurt) and harmful (e.g., illness) effect of bacteria.
7.L.3B.1 (a) Use models to compare cells, tissues, organs, and systems.	7.L.3B.1 (b) Use illustrations to arrange cells, tissues, organs, and systems from least to most complex.	7.L.3B.1 (c) Use pictures to identify a cell, tissue, organ, and system.
7.L.3B.2 (a) Obtain data and models to explain how human body systems work together to support life functions.	7.L.3B.2 (b) Use illustrations to identify the life function a human body system supports.	7.L.3B.2 (c) Match life functions to an organ (e.g., heart pumps the blood).

Application of Performance Indicators at the Middle Level—Instructional Activities

7.L.3B.2 (b) Use illustrations to identify the life function a human body system supports.

- Begin with illustrations or posters of the following human body systems: circulatory, muscular, skeletal, nervous, digestive, respiratory.
- Begin by discussing what we see. These are all views of the human body, but what is different about them? Are they wearing different clothes? No. These are all different views of what is inside your body, beneath your skin.
- What do we notice about each one? Get kids to notice that some are in the whole body, and some are in only parts of the body. All have numerous parts that are connected some way.
- Ask the students to name the six systems.
- Then compare the different body systems with different things. For example:
  - A house frame can be compared to our skeletal system because it helps support and hold up a house just like our skeletal system supports our body.
  - Wires in a cell phone can be compared to our nervous system because they send signals throughout the phone, just like our nerves send signals throughout our body.
  - A blender can be compared to our digestive system because it breaks down food like our stomachs do.

Activity adaptation for less complexity

7.L.3B.2 (c) Match life functions to an organ (e.g., heart pumps the blood).

- For students who need a less complex lesson, simplify the learning expectations to focus on matching life functions to an organ (e.g., picture of heart with "pumps blood"; picture of lungs with "breathing").

Activity adaptation for more complexity

7.L.3B.2 (a) Obtain data and models to explain how human body systems work together to support life functions.

- For students who have the skills to go further, they can complete a model of a human body by attaching the various systems as they learn about them. Students begin by creating an outline of their bodies (with the help of a friend) and, after learning about each system, completing a model of the system and placing it in the body. Once complete, they can describe to their classmates how the body systems work together to support life, using the systems in their "body" to illustrate.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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

7.L.3A.2 (a) Compare basic structures of plant and animal cells (similarities and differences).

- Materials:
  - Objects: onion, leaf, your hand (or a picture)
  - Microscope slides of an onion cell, leaf cell, skin cell (for microscope)
  - Microscopes
  - Posters of plant cell and animal cell, with parts labeled
- Procedure:

  1. Teacher shows each object one at a time to students and asks what they think each is and what they know about each one.
  2. Teacher reminds students that they have learned that cells are the smallest parts of living things. They are so small that we can see them only under a microscope. The microscope helps us see inside these tiny cells.
  3. Ask students if they think there might be something inside the cells of these objects.
  4. Teacher shows students slides with cells (one for each object) and tells students that there are cells from living things in these slides. If we put them under a microscope, we can see inside the cells. We will look at the cells under the microscope. Then, we will make a bigger picture of what we saw under the microscope to help us remember (posters of cells).
  5. Give students time to experiment with materials. Allow students the opportunity to use the microscope to look at slides of onion cells, leaf cells, and skin cells. As they are looking at each slide, orient the student to the important features of each cell type they are observing such as the shape and presence of a nucleus and cell wall.
  6. Give students the cell posters. Ask students to identify things that are the same about both (e.g., both are models of cells, all cells have parts inside them).
  7. Ask students what is different about the posters (e.g., cells have different shapes and parts).
  8. Lead a discussion with the students about what they have learned. For example, we learned that all living things are made of cells. We can see cells only under a microscope. When we look at cells under a microscope, we see parts inside of them. These parts have special jobs to keep the cell and the living thing alive. We use models of cells to learn about the parts and to remember what they look like. On our models, we see that plant cells are shaped like a rectangle. They have cell walls. They have cytoplasm, cell membrane and nucleus (show parts on model as you name them). Animal cells have a rounded shape. They have a cell membrane. They have cytoplasm and a nucleus.

Writing idea:

Have students complete the concept statement using words, pictures, object representations, or switches.

"Cells have <u>parts</u>."

Seventh Grade

Core Concept: Life Science: Heredity—Inheritance and Variation of Traits

It is essential for students to know: Offspring may have similar characteristics as their parents due to inherited traits (DNA) that are passed from parents to offspring. Chromosomes are a structure found in the nucleus of a cell that contain the genetic information. A gene is a segment of DNA found on a chromosome that determines the inheritance of a particular trait (7.L.4A.1). A Punnett square can be used to predict the probability that offspring will inherit the dominant or recessive gene for a particular trait (7.L.4A.3).

Most Complex ⟵		⟶ **Least Complex**
7.L.4A.1 (a) Classify traits by genotype and phenotype.	7.L.4A.1 (b) Match the traits of parents with their offspring (e.g., fur color, flower shape, hair type).	7.L.4A.1 (c) Identify plant or animal traits (e.g., hair color, eye color).
7.L.4A.3 (a) Use models (e.g., a Punnett square) to predict whether an offspring will have a recessive or dominant trait.	7.L.4A.3 (b) Use a Punnett square to identify the offspring with recessive and dominant traits.	7.L.4A.3 (c) Identify a Punnett square. Identify a dominant trait in a Punnett square.

Application of Performance Indicators at the Middle Level—Instructional Activities

7.L.4A.1 (b) Match the traits of parents with their offspring (e.g., fur color, flower shape, hair type).

- Using a Smart Board or PowerPoint presentation, show students pictures of parents and babies and ask them to match parents to babies based on genetic traits. For example, show a picture of a penguin (parent) and two or three options for babies (e.g., chick, baby penguin, calf). Ask students to match the parent with the baby by looking at the traits of the animals. Which animals have similar traits? Look at the wings, beak, and feet. Only one of these babies matches the parent. Have students make more matches using different animals and plants. Ask them to identify the traits that give them clues. Be sure to incorporate some more difficult matches (e.g., caterpillar and butterfly, mature cactus and baby plant, mature plant and seedling). Another way to do this activity is to have students look at a picture and name the genetic traits they see. For example, ask them to name five genetic traits of a toucan (e.g., large beak, banana-shaped beak, two colors in its beak, clawed feet, and feathers). After they have done several of these and are comfortable with the concept of "genetic traits," ask students to name the genetic traits they get from their parents.

Activity adaptation for less complexity

7.L.4A.1 (c) Identify plant or animal traits (e.g., hair color, eye color).

- For students who need more support in the lesson above, simplify the lesson by focusing on the student's genetic traits. Glue a picture of the student's parents or close relative on a piece of paper along with a picture of the student. Talk about the genetic traits they have in common with their parents (e.g., you have blue eyes like your mom; you have brown hair like your dad). Make a list (using pictures paired with keywords) of several of the student's genetic traits and glue the traits on the paper (e.g., hair color, eye color). Display their work in the classroom.

Activity adaptation for more complexity

7.L.4A.1 (a) Classify traits by genotype and phenotype.

- Show students the table below that describes dominant and recessive traits of a dog. These traits determine what a dog looks like (phenotypes). Explain that together, they are going to create different dogs based on these traits.
- Let students create pictures of dogs using combinations of dominant and recessive traits. Students may also do an Internet search for images of dog with a combination of dominant and recessive traits.

Heads (dominant)	Tails (recessive)
Brown eyes	Blue eyes
Short fur	Long fur
Black fur	White fur
Floppy ears	Pointed ears

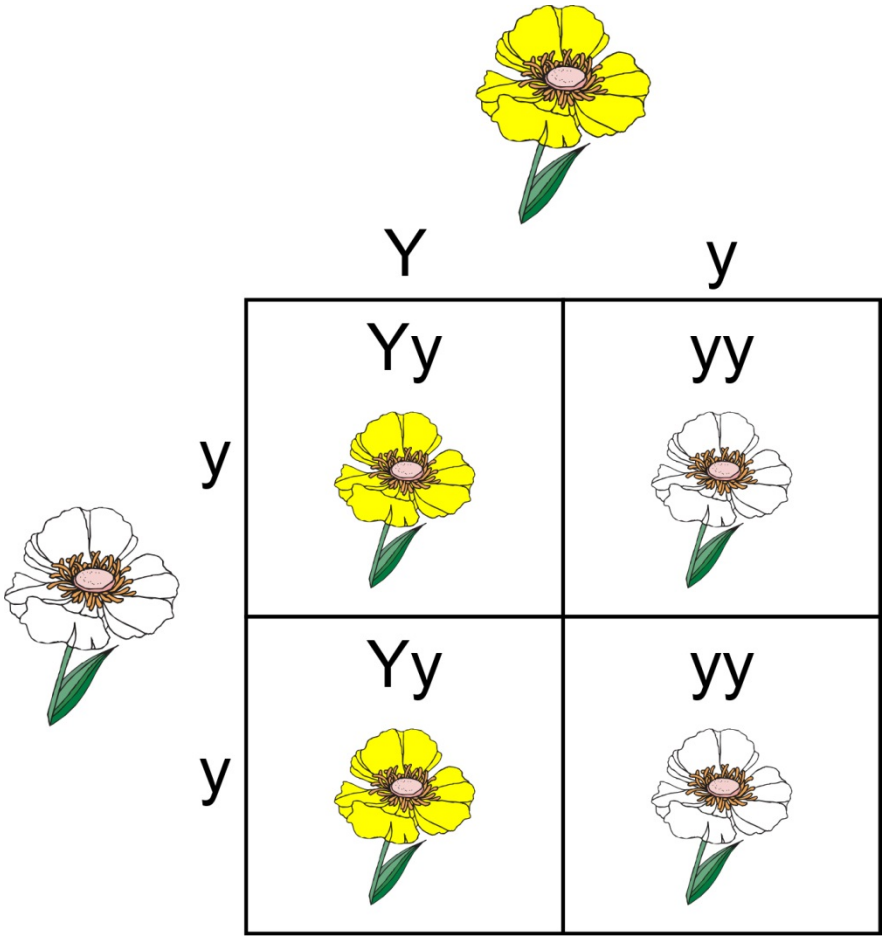
- Have students exchange their picture of a dog. Then instruct the students to put an X next to the traits that are dominant, and an O next to the traits that are recessive to classify each of the phenotypes as being dominant or recessive.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

7.S.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) collect and analyze data, (3) express relationships between variables for models and investigations, or (4) use grade-level appropriate statistics to analyze data.

7.L.4A.3 (a) Use models (e.g., a Punnett square) to predict whether an offspring will have a recessive or dominant trait.

- Begin by demonstrating how to complete a Punnett square for a cross between a heterozygous dominant yellow flower (Yy) and homozygous recessive white flower (yy).



- How many of the offspring flowers would be yellow, and how many would be white?
- Then introduce a new trait: solid-color petals will be dominant and striped petals will be recessive. The letter for the dominant allele will be S, and the recessive allele will be s.

- Have the students complete the Punnett square of the following cross. Be sure to explain that both of these parents would be solid, because they both have the dominant allele.

	S	s
S	SS	Ss
s	Ss	ss

Ss	
SS	
ss	

- How many of the offspring flowers would have solid petals and striped petals?

Seventh Grade

Core Concept: Ecology: Interactions of Living Systems and the Environment

It is essential for students to know: The organization in the natural environment from most simple to most complex includes species, populations, communities, ecosystems, and biomes. Each level is defined by the type and number of biotic and/or abiotic factors present (7.EC.5A.1). Various factors can change the environment, including natural hazards and limiting factors. They all have similar effects on the environment and can affect one another. This can lead to competition for food, water, space, and shelter (7.EC.5A.3). In any ecosystem, organisms can have interactions that allow them greater access to resources. These interactions can lead to competition for resources (7.EC.5B.1). Organisms have energy roles in their environment. The roles are determined by how they obtain energy and interact with other organisms. The flow of energy in an environment can be represented by food webs and energy pyramids (7.EC.5B.2). Changes in the environment can occur due to changes in the populations (7.EC.5B.3).

Most Complex ⟵		⟶ **Least Complex**
7.EC.5A.1 (a) Illustrate the populations, communities, and abiotic factors (e.g., soil, water, and temperature) in an ecosystem.	7.EC.5A.1 (b) Identify the populations in a community.	7.EC.5A.1 (c) Use pictures to identify a population of organisms (e.g., daisies in a field, gray squirrels in the woods).
7.EC.5A.3 (a) Analyze and interpret data to predict changes in the number of organisms within a population when certain changes (due to natural hazards, limiting factors, climate, or availability of resources) occur to the physical environment.	7.EC.5A.3 (b) Use observational data to describe what happens to the organisms (e.g., increase/decrease, leave) when floods, fire, too much rain, or other limiting factors change the environment.	7.EC.5A.3 (c) Match the change in the environment with its effect (e.g., too many fish in a pond limits space and food; wildfires destroy food and shelter for deer).
7.EC.5B.1 (a) Use models to explain the interactions between organisms in an environment that lead to competition and how the organisms mutually benefit.	7.EC.5B.1 (b) Use pictures to match predator and prey in an environment.	7.EC.5B.1 (c) Identify predator and prey (animals).
7.EC.5B.2 (a) Use models and data to demonstrate how the energy flows in a simple food web.	7.EC.5B.2 (b) Illustrate the energy flow in a simple food chain.	7.EC.5B.2 (c) Recognize a simple food chain that includes a producer (e.g., grass) and a consumer (e.g., cow).
7.EC.5B.3 (a) Predict how the change in population size for one species will impact the number of other species in an environment (e.g., if the snake population increases, the population of rodents will decrease).	7.EC.5B.3 (b) Identify an impact that population size of one species will have on others in an environment.	7.EC.5B.3 (c) Identify causes for changes in a population.

Application of Performance Indicators at the Middle Level—Instructional Activities

7.EC.5B.2 (b) Illustrate the energy flow in a simple food chain.

- Using a Smart Board or PowerPoint presentation, introduce the idea of a simple food chain.
  - A food chain shows how energy moves through an ecosystem. Plants are producers in an ecosystem. Plants are found at the beginning of a food chain because they get their energy from the sun. A primary consumer is an organism that eats producers. A secondary consumer is an organism that eats herbivores, and a tertiary consumer is a predator that eats organisms in levels below.
- Ask students to identify a primary consumer in a habitat that the students are familiar with. Do research in books or online to find out what the primary consumer eats. Then find out what eats the primary consumer. Illustrate your food chain together on the board or on separate worksheets.
- Food Chain Activity: Divide students into groups of four and assign each student in the group one of the following roles: caterpillar, bird, trees/plants, or wasps (each group will have one of each). Have the students form a line to represent the food chain. Ask students to think about who they are and where they would likely be in the food chain (beginning, middle, end). Remind students that every food chain has to begin with a producer.
- Food chain example:

After discussing as a group, students should create the food chain in their Science Journals.

Activity adaptation for less complexity

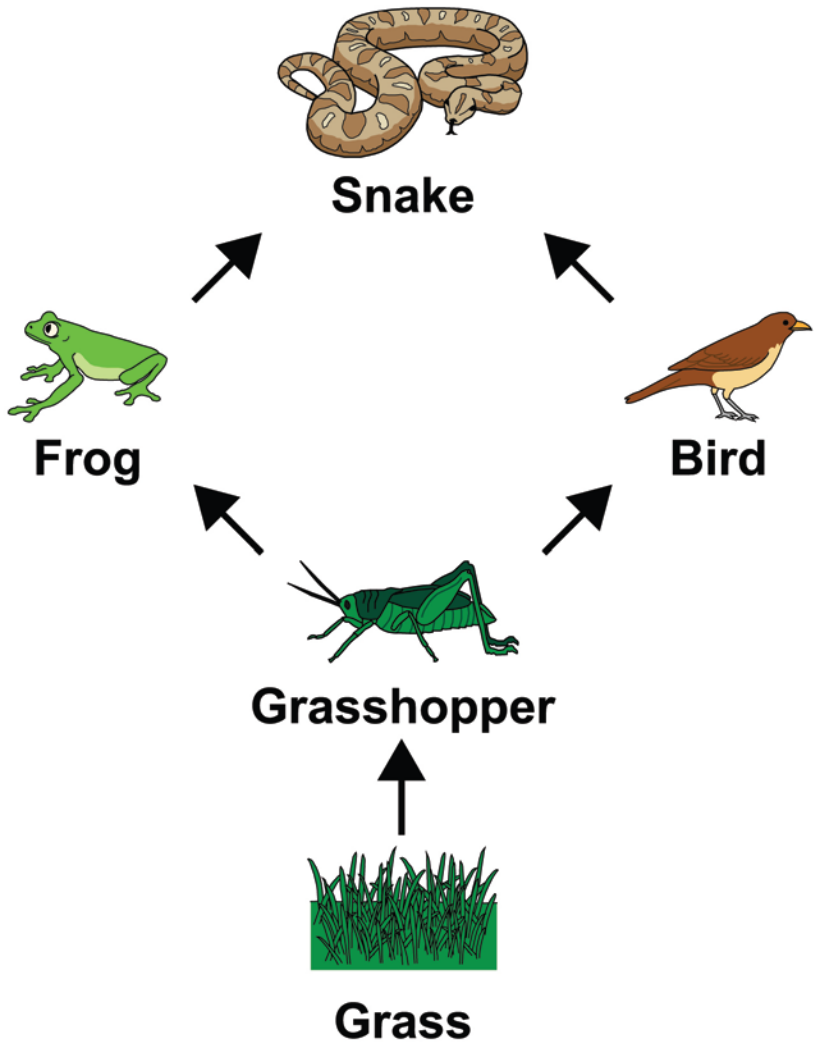
7.EC.5B.2 (c) Recognize a simple food chain that includes a producer (e.g., grass) and a consumer (e.g., cow).

- For students who need more support in the lesson above, divide students into groups of two. One student in the group is the "producer" and the other is the "consumer." Give students pictures of actual producers and consumers. Have each pair create chains of a producer and a consumer. Students should find their matching producer or consumer from the opposite group. Students will then use their pictures to create a chart showing which producer is paired with each consumer.

Activity adaptation for more complexity

7.EC.5B.2 (a) Use models and data to demonstrate how the energy flows in a simple food web.

- For students who have the skills to go further in the lesson, ask them to add two more consumers that compete for food with members of the food chain and describe the flow of energy in the food web created by the students.
- The arrows in the web point to where the energy is going.



Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

7.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

7.EC.5B.3 (b) Identify an impact that population size of one species will have on others in an environment.

- A keystone species is a species that has a disproportionally large impact on the ecosystem (e.g., bees, wolves in Yellowstone National Park, prairie dogs, humming-birds, sea otters, jaguars, elephants)
- Have students help gather information about a keystone species.
- Then, as a class create a food chain or web on a poster that shows the flow of energy to and/or from their chosen keystone species.
- Have students share a piece of information they have learned about the animal the class is studying. A report based on the information the students have learned can be made by writing facts about the animal on sentence strips (or using whiteboard technology). As each student shares a fact, have the student assist with placing the corresponding sentence strip on display. After each student has shared a fact and placed the sentence strip in order, read the report in its entirety to the students. Reports should include the diets of the animals in the ecosystem, what the environment is like, and what would happen to the other animals in the food chain or web if the population of the keystone species declined (see the report template below). Students could work with a peer buddy or service learner on this activity.

Report template:

Our keystone species is _____. They live in _____. They are important because _____. If the number of (keystone species) goes down, this affects other species by _____.

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Age 13 on or before September 1 (Grade 8)

Eighth Grade

Core Concept: Physical Science: Forces and Motion

It is essential for students to know: The motion of an object (speed and direction) is determined by many factors (8.P.2A.1). Forces, including gravity and friction, can affect the speed and direction of an object (8.P.2A.5). Motion occurs when there is a change in position of an object with respect to a referenced starting point (8.P.2A.6).

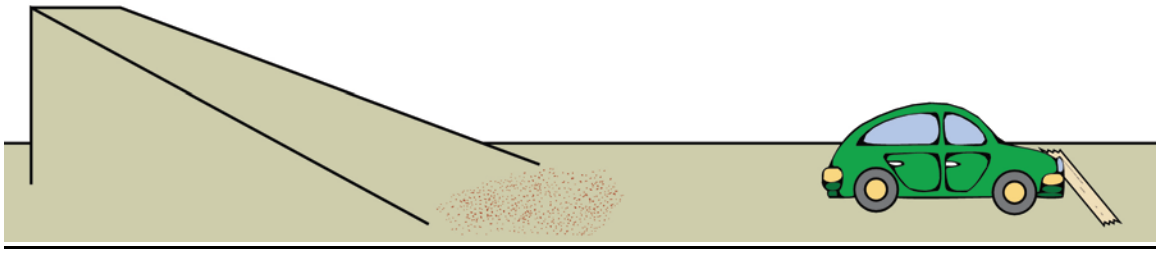
Most Complex ←		→ **Least Complex**
8.P.2A.1 (a) Conduct scientific investigations to test how varying the amount of force or mass of an object affects the motion (speed and distance) of an object.	8.P.2A.1 (b) Use models to predict how the motion of objects with different masses will be affected by the same amount of force (e.g., which will travel farther: a golf ball or a ping pong ball?).	8.P.2A.1 (c) Identify which objects require more force to move based on mass.
8.P.2A.5 (a) Analyze and interpret data to describe and predict the effects of forces (including gravity and friction) on the speed and direction of an object.	8.P.2A.5 (b) Use models to illustrate the effect of gravity or friction on the motion of an object.	8.P.2A.5 (c) Use models to demonstrate that gravity makes objects fall downward when they are released.
8.P.2A.6 (a) Conduct an investigation to compare speed and slope of two graphs.	8.P.2A.6 (b) Plot change in position in a distance/ time graph.	8.P.2A.6 (c) Understand that an object has changed position over time.

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

8.P.2A.5 (b) Use models to illustrate the effect of gravity or friction on the motion of an object.

- Together as a class, design a ramp and floor surface that prevents a car from rolling past a certain point.
- Materials:
  - An adjustable ramp
  - Tape
  - A toy car
  - Sand (or sand paper, carpet squares various textured surfaces)
  - A smooth surface where you can add sand to vary the amount of friction
- First demonstrate to the students how the height of a ramp affects the distance a car will roll once it leaves the ramp. To do this, roll a car down two ramps of varying height. Mark how far each car traveled. Discuss what made the car roll farther. A higher or a lower ramp (a higher ramp)?

- Discuss with the students how friction affects motion. Explain that a car will not roll as far on a rough surface as a smooth one. Then demonstrate to the students how the amount of friction on the surface affects the distance a car will roll once it leaves the ramp. Vary the amount of friction by adding more sand to the surface.
- Set a target location for the car to stop by marking a spot on the floor with tape. Note: this location should be between the ramp and the farthest tape mark from step one.
- Have the students make suggestions for how to adjust the ramp and/or how much sand to add or remove so that the car rolls exactly to that point. Continue guiding the students as they make suggestions and repeat trials until the car stops on the target location. After each attempt, conduct a think aloud with the students to reinforce the impact of their suggestion. For example, "We added sand, but the car still rolled past the target spot. Do you think we should add more sand, or take some away?" etc.



Activity adaptation for less complexity

8.P.2A.5 (c) Use models to demonstrate that gravity makes objects fall downward when they are released.

- For students who need more support, reduce the learning expectation to demonstrating that an object will fall downward when it is dropped. Demonstrate this concept by dropping (or having the student drop) objects from around the classroom. Tell the student to watch (or listen or feel) what happens when you drop something. Then ask students what happened to the objects (they fall to the floor). Explain that it was the force of gravity that made them fall to the ground (rather than float in the air) when you let go of them. After doing several demonstrations using different objects, ask students to predict what will happen when an object is dropped (It will fall to the ground). You can use actual objects to complete a simple chart about the results. After gathering data from these demonstrations, ask students did objects fall to the ground (yes)? Why did they fall to the ground (Gravity causes things to fall to the ground)?

Object Dropped	Yes	No
Book		
Eraser		

Activity adaptation for more complexity

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

- For students who have the skills to go further, ask the following questions after completing the lesson:
  - How can we make the car roll farther by adjusting only the ramp height? (Raise the height of the ramp)
  - How can we make the car roll farther by adjusting only the amount of friction on the surface? (Decrease the amount of friction on the surface)
- Note: Perform each investigation separately to answer these questions.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

8.S.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) collect and analyze data, (3) express relationships between variables for models and investigations, or (4) use grade-level appropriate statistics to analyze data.

8.P.2A.1 (b) Use models to predict how the motion of objects with different masses will be affected by the same amount of force (e.g., which will travel farther: a golf ball or a ping pong ball?).

- Materials:
  - Ramp
  - Golf ball
  - Tennis ball
  - Ping pong ball
  - Basketball
  - Bowling ball
  - Something to measure with (floor tiles, measuring tape)
  - Masking tape to mark distance, something to measure mass (e.g., triple-beam balance)
- Make a ramp with text books at least six to twelve inches high in an open space that can be easily measured (hallway, cafeteria floor, gym). Note: the greater the mass of the balls you choose to use, the more floor space you will need to conduct this investigation.
- Complete a graph for the classroom.
- Gather a variety of three to five balls with different masses.
- Measure the mass of each ball and record in the chart.
- Place the ball at the top of the ramp. Release the ball without pushing.
- Mark the stopping point and measure. Record results in data chart.
- Repeat steps for additional balls.

- Ask: Which ball had the greatest mass? Which ball travels the farthest? (The heaviest ball [the ball with the most mass] travels the farthest)

Ball	Mass	Distance

Writing idea:

Complete the following concept statement with words, pictures, or object representations.

“Objects with more mass travel the farthest.”

Eighth Grade

Core Concept: Earth Science: Earth's Place in the Universe

It is essential for students to know: Objects in the solar system have a variety of characteristics based on their surface features. These objects move in a variety of ways (8.E.4B.1). The sun is the center of the universe. All planets orbit the sun. The Earth rotates at an angle on its axis, resulting in seasonal changes (8.E.4B.3). Tides and the orbit of planets are affected by the pull of gravity. All objects in the solar system are in constant motion. On the Earth, this constant movement results in days and years (8.E.4B.4). Astronomers use telescopes and satellites to collect data about objects inside the solar system (8.E.4B.5).

Most Complex ←		→ **Least Complex**
8.E.4B.1 (a) Use models to summarize and compare the characteristics and movements of objects in our solar system (including planets, moons, asteroids, comets, and meteors).	8.E.4B.1 (b) Model movement of objects in the solar system (revolution/rotation).	8.E.4B.1 (c) Identify objects in our solar system (sun, planets, moon, and comets).
8.E.4B.3 (a) Use models to explain the relationship between the seasons and the length of day.	8.E.4B.3 (b) Use models or illustrations to identify the Earth's seasons and relate them to the Earth's tilt and relative position to the sun.	8.E.4B.3 (c) Match the Earth's seasons to temperature changes.
8.E.4B.4 (a) Use models to explain how motions within the sun-Earth-moon system result in the Earth's day (twenty-four hours) and year, and the moon phases.	8.E.4B.4 (b) Use models to illustrate phases of the moon.	8.E.4B.4 (c) Recognize that the moon's appearance changes (based on its revolution around the Earth).
8.E.4B.5 (a) Describe how data from technologies (e.g., telescopes, and satellites) provide information about objects in our solar system and the universe.	8.E.4B.5 (b) Explain the function of a telescope.	8.E.4B.5 (c) Use pictures to identify tools that are used to study space (e.g., telescope and satellite).

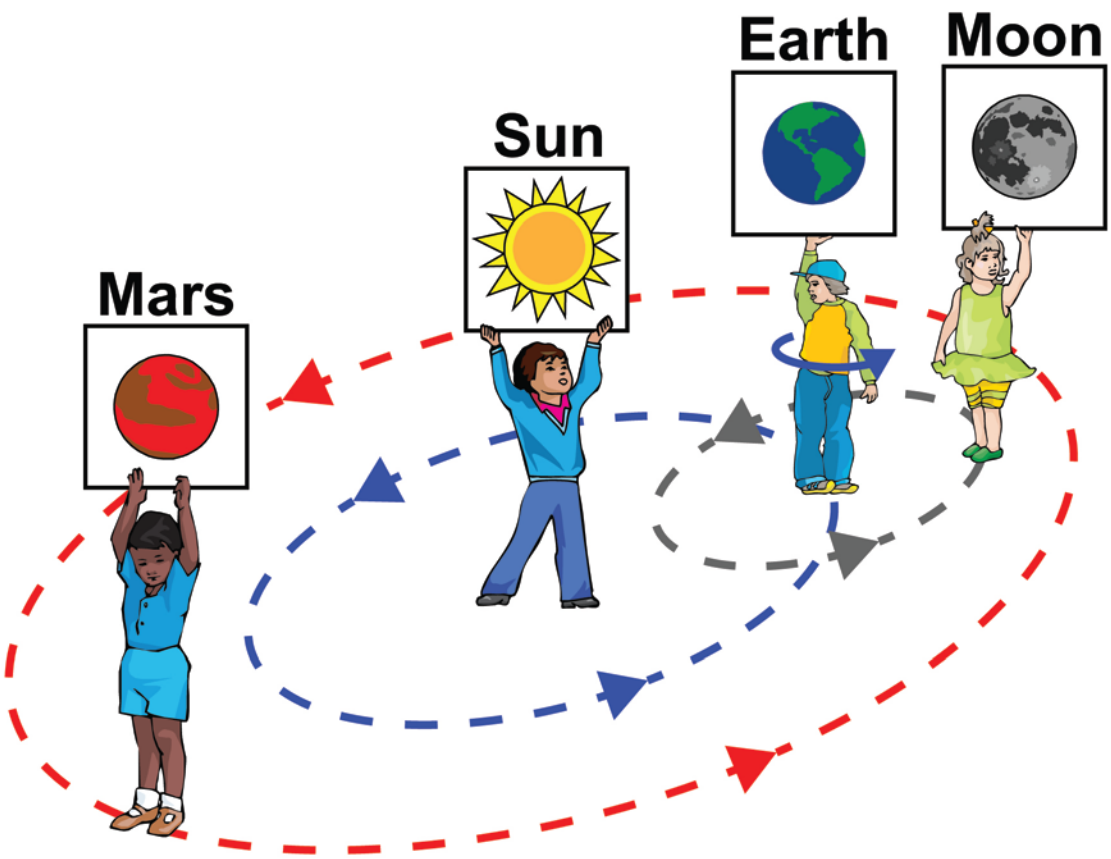
<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

8.E.4B.1 (b) Model movement of objects in the solar system (revolution/rotation).

- To demonstrate the movement of objects in the solar system, have students participate in the solar system dance. To begin, assign students one of the following (i.e., Mercury, Venus, Earth, Earth's moon, Mars, Jupiter, Saturn, Uranus, Neptune). You can use all or just a few of the objects found in the solar system. Use different-colored tape on the floor to help students know where to walk. Set everyone in motion for the dance.

- Questions for discussion:

    1. Which object is at the center of the solar system? (sun)
    2. What object do the planets orbit around? (sun)
    3. What objects does Earth's moon orbit around? (Earth)
    4. From what object do the planets receive light and warmth? (sun)
    5. What planet do we live on? (Earth)
    6. What do we revolve around? (sun)
    7. What revolves around us? (moon)



<u>Activity adaptation for less complexity</u>

8.E.4B.1 (c) Identify objects in our solar system (planets, moon, and comets).

- For students who need more support, ask them to identify objects commonly found in the solar system (planets, moon, sun). Pictures of these objects can be used from the lesson above. For students with visual impairments, a lamp can be used for the sun, pictures can be made tactile by adding textures, and different sized balls can be used for the planets.
- Ask the students, "What kind of objects can we see from Earth?" (The sun, moon, and stars. Sometimes we can see planets, but they look like stars unless you view them with a telescope.)
- Explain to the students that the moon is much smaller than the planets in our solar system. Why does the moon *appear* to be larger? (Because it is much closer to the earth than the other objects in space.)

Activity adaptation for more complexity

8.E.4B.1 (a) Use models to summarize and compare the characteristics and movements of objects in our solar system (including planets, moons, asteroids, comets, and meteors).

- For students who have the skills to go further, ask them to research the objects in our solar system (nine planets, the sun, and Earth's moon) using resources from the library, classroom, and/or Internet. Providing them with a graphic organizer will help them organize the information they find. They can organize the information they find in different ways: by individual planets, planet size, distance from the sun (near or far), whether the planet has rings or moons, and type of planet (solid or gas). After they complete their research, ask them to make posters for each of the objects. These posters can be displayed around the room and/or used in the solar system dance in the lesson above.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

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

8.E.4B.5 (a) Describe how data from technologies (e.g., telescopes and satellites) provide information about objects in our solar system and the universe.

- Discuss with students what a satellite is and how we use them (e.g., weather, Google Earth).
- As a class, choose an artificial satellite or telescope on which to find out more information. The satellite can orbit Earth or any other celestial body. The telescope may be stationary on Earth or attached to a satellite or other space probe.
- The report should describe the location of the device, the information it is collecting, how it benefits people, the future of the device, and images or data it has captured/collected.
  - Examples might include the telescopes at the Mauna Kea Observatory, Hubble telescope, the Soil Moisture Active Passive (SMAP) satellite.

Eighth Grade

Core Concept: Earth Science: Earth Systems and Resources

It is essential for students to know: Weathering, erosion, and deposition are the processes that act together to wear down and build up the Earth's surface (8.E.5A.1). The Earth has layers that have specific conditions and composition (8.E.5A.3). The Earth was once one large mass. As a result of plates moving throughout history, the Earth's land mass has divided into continents, and oceans were formed (8.E.5A.4). Earthquakes and volcanic eruptions occur in specific areas along plate boundaries (8.E.5B.2). The Earth's resources have properties that make them useful (8.E.5C.1).

Most Complex ←		→ **Least Complex**
8.E.5A.1 (a) Describe how the processes of weathering, erosion, and deposition change surface features in the environment.	8.E.5A.1 (b) Classify the processes of weathering, erosion, and deposition that change surface features in the environment.	8.E.5A.1 (c) Match a process of weathering, and deposition to changing surface features in the environment.
8.E.5A.3 (a) Identify the composition and position of the Earth's layers (crust, mantle, and core).	8.E.5A.3 (b) Use models to illustrate the layers of the Earth.	8.E.5A.3 (c) Identify the crust of the Earth as the outermost layer upon which we live.
8.E.5A.4 (a) Use models to illustrate the movements of Earth's plates to form continents and oceans, mountains and volcanoes.	8.E.5A.4 (b) Describe the movement of the Earth's plates.	8.E.5A.4 (c) Identify that the Earth's crust is divided into plates.
8.E.5B.2 (a) Obtain data and use models to describe how forces inside the Earth result in earthquakes and volcanoes.	8.E.5B.2 (b) Recall that earthquakes and volcanoes occur at plate boundaries.	8.E.5B.2 (c) Observe locations and patterns of earthquakes and volcanoes.
8.E.5C.1 (a) Obtain information regarding the physical and chemical properties of minerals, ores, and fossil fuels to describe their importance as the Earth resources.	8.E.5C.1 (b) Identify the properties of minerals (hardness, luster).	8.E.5C.1 (c) Identify Earth's resources (e.g., minerals, ores, and fossil fuels).
8.E.6A.4 (a) Use fossils to provide evidence of (1) the diversity of life that has been present on Earth, (2) relationships between past and existing life forms, and (3) environmental changes that have occurred during the Earth's history.	8.E.6A.4 (b) Match fossil to life forms or related environment.	8.E.6A.4 (c) Match the fossil to the organism that created it.

Application of Performance Indicators at the Middle Level—Instructional Activities

8.E.5A.1 (b) Classify the processes of weathering, (physical) erosion, and deposition that change surface features in the environment.

- Begin by differentiating among weathering, erosion, and deposition.
  - Weathering is the breaking down of rock into smaller pieces.
  - Erosion is the movement of those pieces, often by wind, water, glacial movement, or gravity.
  - Deposition occurs when the wind or water carrying the sediments slows down enough for the sediments to settle or when ice melts and the sediments fall from it.
- Model one process of weathering by completely filling a plastic bottle with water, placing it safely into a plastic bag, and then placing it into a freezer overnight. Explain to the students that water expands when it freezes. Observe how the plastic bottle broke when the water froze. When water repeatedly freezes in the cracks of stone, it can have the same effect over a long period of time.
- Model both erosion and deposition by piling up sand at the top end of a paint roller pan. Pour water from the top and let it carry the sand toward the bottom. The water eroded the sand by carrying the sediments away. Then the sediments were deposited at the base of the paint roller pan.

Activity adaptation for less complexity

8.E.5A.1 (c) Match a process of weathering and deposition to changing surface features in the environment.

- For students who need additional support with the lesson above, simplify the learning objective to identifying pictures or objects that represent weathering, erosion, and deposition (smooth rock to represent weathering).
- Ask students to sort the pictures or representational objects into each category. Also, videos with sounds such as waterfalls can be used to sort.

Activity adaptation for more complexity

8.E.5A.1 (a) Describe how the processes of physical and chemical weathering, erosion, and deposition change surface features in the environment.

- For students who have the skills to go further, ask them to think about the question, “How does erosion affect my world”? Provide students with three pictures over time that illustrates deposition and erosion. Have them put the pictures in order and share the results with the class.
- Have each student select an area around their school, home, or community to observe. They can record their observations in a Science Journal or by taking pictures of the site they selected. Have students share their observation with the class.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

8.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.

8.E.5A.3(b) Use models to illustrate the layers of the Earth.

- Students will create a model of Earth's layers.
- Materials:
  - A marble
  - A balloon (or a plastic Easter egg, or a plastic ornament)
  - Water
  - Softened modeling clay
  - Sand
- Explain to the student that the marble will represent the inner core. Like the inner core, the marble is solid.
- Stretch out the balloon by blowing it up several times. Add the marble to the balloon and put enough water into the balloon so that it surrounds the marble—but not enough water to cause the balloon to expand. Explain to the student that the water surrounding the marble is fluid like the Earth' outer core.
- Carefully form a very thick shell around the balloon with the softened modeling clay. Explain to the student that the mantle is a dense layer of semisolid rock.
- Finally, roll the ball in the sand. The sand represents the crust. Explain that it is the topmost layer that we live on and it is the thinnest.
- Because the mantle is still malleable, have the students try pinching pieces of the Earth's surface to create mountain ranges in the crust.

Discussion:

In the model, what does the marble represent? (the Earth's inner core)

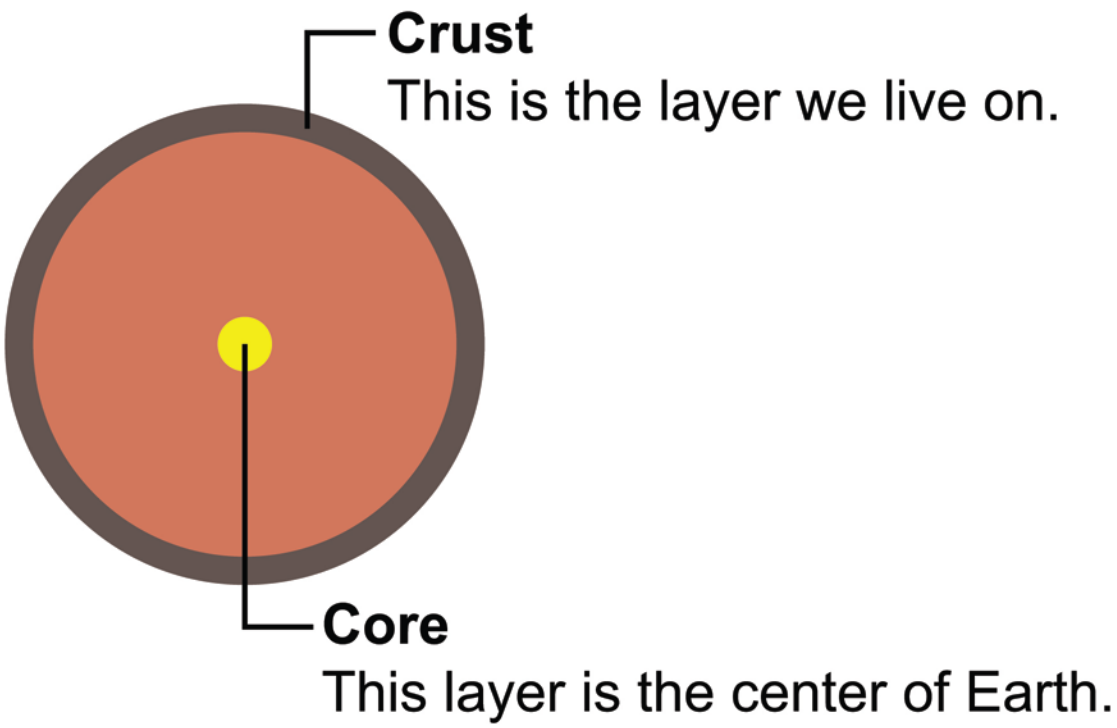
In the model, what does the water represent? (the Earth's outer core)

In the model, what does the modeling clay represent? (the Earth's mantle)

In the model, what does the sand represent? (the Earth's crust)

Writing idea:

Provide students with a picture of the model of the earth. Using a word bank (i.e., inner core, outer core, mantle, crust), have students label the different layers of the earth. Finally, have students match a fact about each of the layers.



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Age 16 on or before September 1 (Biology)

Biology

Core Concept: Cells as a System

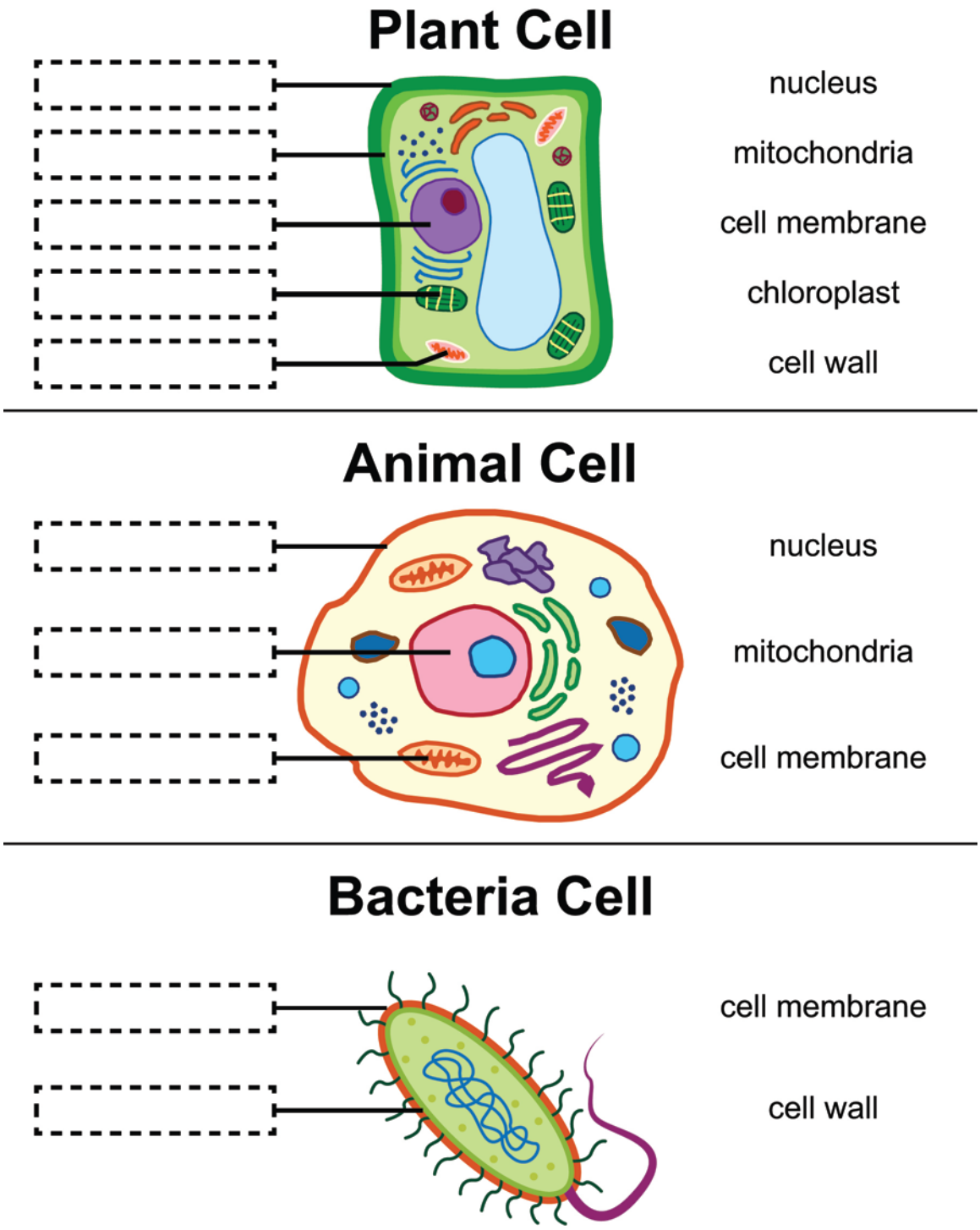
It is essential for students to know: All organisms are composed of organic molecules (H.B.2A.1). Plant, animal, and bacteria cells have different characteristics such as size, shape and structures. (HB.2B.2). Water needs to be able to move into and out of a cell (H.B.2C.3). Cellular division is necessary for organisms to grow. When cells divide in multicellular organisms, they take on specific roles (for example, blood, muscle, bone, nerve cell) (H.B.2D.1).

Most Complex ←		→ **Least Complex**
H.B.2A.1 (a) Identify the functions of carbohydrates, lipids, proteins, and nucleic acids.	H.B.2A.1 (b) Match carbohydrates, lipids, proteins, and nucleic acids with their functions.	H.B.2A.1 (c) Recognize that all organisms are composed of molecules.
H.B.2B.2 (a) Categorize cells as plant, animal, or bacteria.	H.B.2B.2 (b) Sort plant, animal and bacteria cells.	H.B.2B.2 (c) Match plant, animal, and bacteria cells.
H.B.2C.3 (a) Describe what happens when water moves into and out of a cell (into the cell—swells; out of the cell—shrivels).	H.B.2C.3 (b) Sort cells by appearance to categorize whether water has moved in or out of them.	H.B.2C.3 (c) Identify a cell that has had water move into and out of it.
H.B.2D.1 (a) Explain what happens in cell differentiation (cells take on different roles) or describe the results of cell differentiation (cells turning into specialized cells, taking on specialized roles).	H.B.2D.1 (b) Using a model, sequence the steps of cell division and differentiation.	H.B.2D.1 (c) Identify a model of cell division.

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

H.B.2B.2 (b) Sort plant, animal, and bacteria cells.

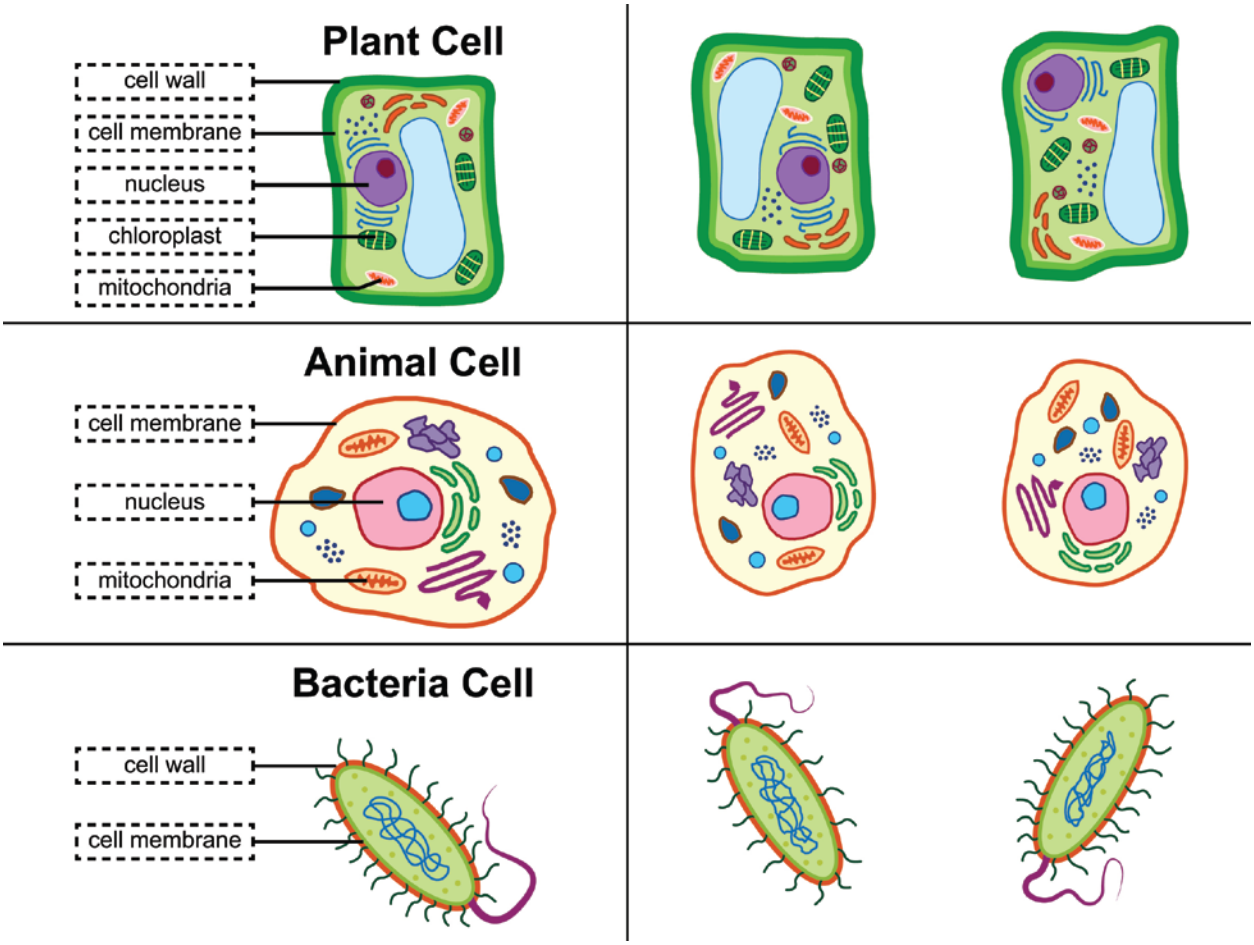
- Have the students label a diagram comparing plant, animal, and bacteria cells, and then sort pictures or diagrams of different plant, animal, and bacteria cells.
- Materials:
  - Diagrams of a plant, animal, and bacteria cells with space to place labels
  - Labels for the diagrams
  - Cards with pictures or diagrams of different plant, animal, and bacteria cells
  - Examples of diagrams, labels, and cards are shown below



- Assist the student in labeling the cells. “Plant Cell” should be labeled with the following parts: a cell membrane, a cell wall, nucleus, mitochondria, and chloroplasts. “Animal Cell” should be labeled with the following parts: a cell membrane, nucleus, and mitochondria. “Bacterial Cell”

should be labeled with the following parts: a cell membrane, and cell wall. Note that the bacterial cell should also be considerably smaller than the plant and animal cells.

- Give the students cards showing animal, plant, or bacteria cells, and have the students sort them using the labeled diagrams. To extend the activity, once the student has correctly sorted the types of cells, ask him or her to identify parts of the cell on the unlabeled cards. (The student can use the labeled diagram for reference.) The example below shows cards sorted next to each diagram.



- For students with visual impairments, create 3D models with the students using the following suggested materials:
  - For the plant cell, use a box such as a shoebox. The outer edges of the box represent the cell wall. Line the inside of the box with a soft liner such as felt or a plastic bag to represent the cell membrane. The chloroplast could be represented by a green jelly bean. The nucleus and mitochondria should be represented by the same material in both the plant and animal cell. The nucleus may be a small pom-pom while the mitochondria could be represented as paper clips.
  - For an animal cell, use a basketball cut in half or a plastic bag to represent the cell membrane.
  - For the bacterial cell, be sure to use something significantly smaller than the plant and animal cell, such as a dried bean.

Activity adaptation for less complexity

H.B.2B.2 (c) Match plant, animal, and bacteria cells.

- Provide the students with cell diagrams (or 3D models) that have the relevant parts labeled.
- Describe each part of the cell.
- Then provide the student with cards showing labeled pictures or diagrams of different animal, plant, or bacteria cells, and have them sort the similar, unlabeled cards onto the diagrams.

Activity adaptation for more complexity

H.B.2B.2 (a) Categorize cells as plant, animal, or bacteria.

- Provide the students with cell diagrams (or 3D models) that show each type of cell but without the parts of the cells labeled and without the titles (or cover the titles for each diagram).
- Provide a word list of the following cell parts:
  - Cell membrane
  - Cell wall
  - Nucleus
  - Mitochondria
  - Chloroplast
- Then indicate each unlabeled part in the diagram or model and ask the students for each part, "Which do you think this is?" As the students respond, label the diagram or model.
- Once the diagrams are labeled, ask the students, "What type of cell do you think this is: plant, animal, or bacteria?" Then add (or reveal) the title.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

H.B.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs, or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

H.B.2C.3 (b) Sort cells by appearance to categorize whether water has moved in or out of them.

- Students will model osmosis by observing de-shelled eggs that will expand when placed in water and shrink when placed in corn syrup.
- Materials:
  - One dozen chicken eggs
  - Vinegar
  - Water

  - Corn syrup
  - Ten to twelve clear plastic cups or other clear plastic containers

- Begin by submerging (or soaking) ten of the eggs in vinegar for forty-eight hours. This will dissolve the hard outer shell of the egg, leaving a semipermeable membrane. Explain to the students that the membrane of the egg will allow water to move into and out of the egg. Show the students the remaining shelled eggs. Allow the students to observe the difference between the shelled eggs and the de-shelled eggs. The de-shelled eggs are fragile and must be handled carefully.
- Pour water into five of the cups and then carefully place a de-shelled egg into each cup. Carefully place five de-shelled eggs into five empty cups. Next carefully add corn syrup to the cup. There should be enough liquid in each cup to cover the eggs. Note: The investigation works better if the corn syrup is added after the egg is placed in the cup. The egg in corn syrup will not sink, so you may have to weigh it down.
  - You may choose to place the remaining two shelled eggs into one cup with water and the other into a cup with corn syrup to demonstrate that they will not change.
- The next day, students will compare the de-shelled eggs that were in the water and the de-shelled eggs that were in the corn syrup. Explain to the students that the de-shelled eggs in the water are now larger because water moved into the eggs through the membrane. The de-shelled eggs in the corn syrup are smaller because water moved out of the eggs through the membrane.
  - If you chose to place the two shelled eggs in a cup of water and corn syrup, be sure to explain to the students that the size of the shelled eggs did not change because the hard shell prevented the movement of water into and out of the eggs.

Biology

Core Concept: Energy Transfer

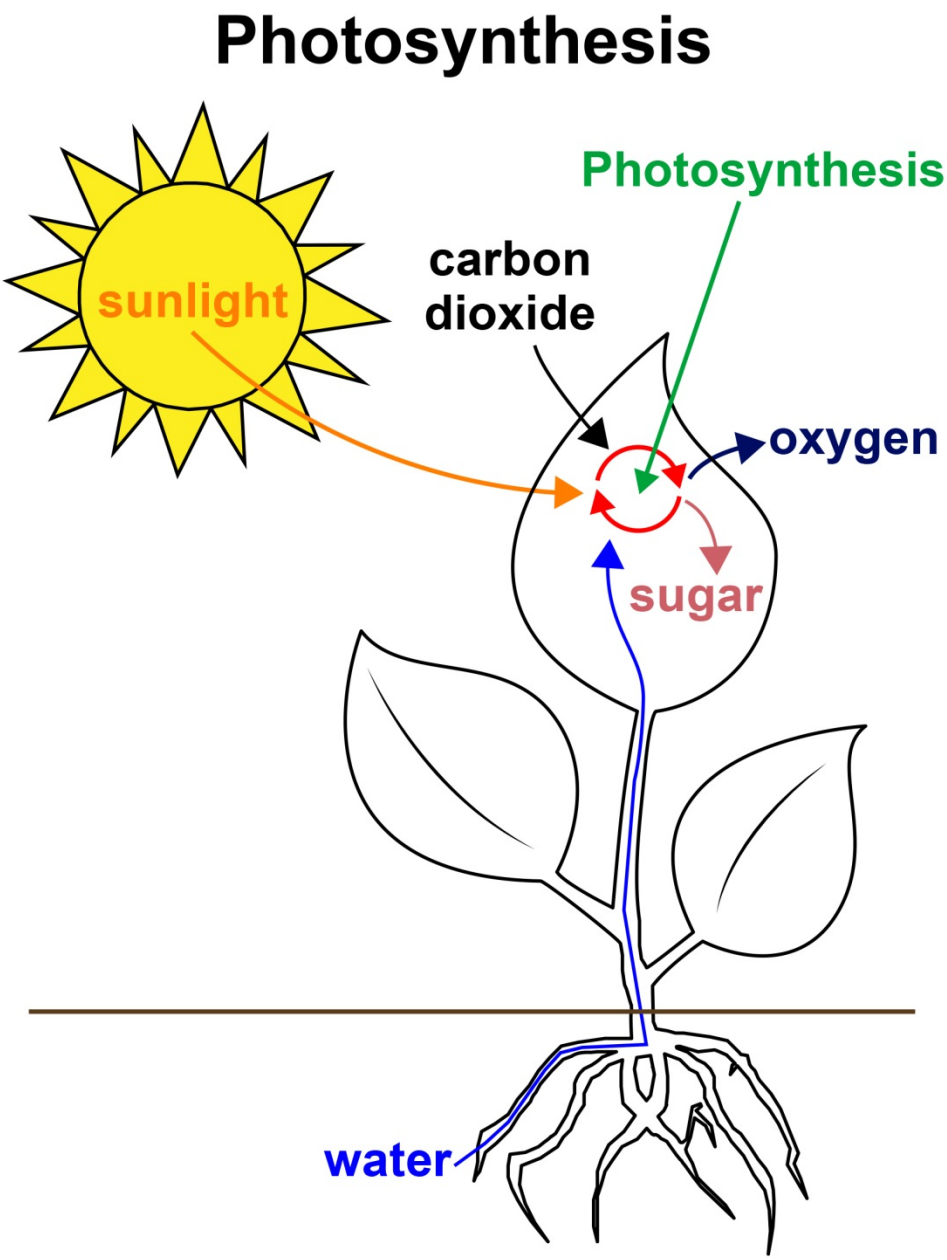
It is essential for students to know: All organisms need a constant source of energy to survive. The ultimate source of energy for most life on the Earth is the sun. Through photosynthesis, plants transform this light energy into stored chemical energy (H.B.3A.2). Cellular respiration is a process that transforms the stored chemical energy in food into energy that organisms can use for life processes (H.B.3A.4).

Most Complex ←		→ **Least Complex**
H.B.3A.2 (a) Summarize the overall process of photosynthesis, using words or pictures, and explain why it is important to the plant.	H.B.3A.2 (b) Order the steps in the process of photosynthesis.	H.B.3A.2 (c) Identify why photosynthesis is important.
H.B.3A.4 (a) Identify that food is transformed into waste energy in the cells.	H.B.3A.4 (b) Identify that organisms transform food into energy that can be used.	H.B.3A.4 (c) Identify food as a source of energy for organisms.

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

H.B.3A.2 (b) Order the steps in the process of photosynthesis.

- Create a diagram (or 3D model) of the chemical reaction for photosynthesis (water + carbon dioxide + sunlight → oxygen + sugar).
- Present the diagram or model to the students.
- Provide the students with a diagram of a plant or an actual plant that has broad leaves and roots.
- Select a point on the leaf where photosynthesis will occur. Label this point ‘photosynthesis’. Have the students draw arrows to and from the point to each component of photosynthesis. You may write the components on the diagram or have paper labels attached to the diagram prior to the students drawing the arrows. An example is shown below.
  - Draw an arrow from the sun to the point on the leaf.
  - Draw an arrow from a carbon dioxide label in the atmosphere to the point on the leaf.
  - Draw a line from a water label in the soil moving through the roots, up the stem, and to the point on the leaf.
  - Draw an arrow from the point on the leaf to an oxygen label in the atmosphere.
  - Draw a line from the point to a sugar label on the leaf.



- For students with visual impairments, create a 3D model with the following suggested materials:
  - Use straws for roots since they are also used to suck up water.
  - Use pipe cleaners for stems.
  - Use paper towels for leaves since they also allow air to move through them.
  - Create a sun from a piece of felt and hand warmers.
  - Carbon dioxide may be demonstrated by exhaling into a sealable plastic bag.

<u>Activity adaptation for less complexity</u>

H.B.3A.2 (c) Identify why photosynthesis is important.

- Begin with one or more pairs of identical plants and provide one plant in each pair access to sunlight, while the other has no sunlight.
- Present the chemical reaction for photosynthesis to the students (water + carbon dioxide + sunlight → oxygen + sugar).
- Explain that the sugar produced by photosynthesis is the plant's food.
- Compare the plant(s) that had access to sunlight to the plant(s) that had no sunlight.
- Discuss why one plant looks healthier than the other.

Activity adaptation for more complexity

H.B.3A.2 (a) Summarize the overall process of photosynthesis, using words or pictures, and explain why it is important to the plant.

- Provide the students with the plant diagram labeled with the components of photosynthesis. (Refer to middle-level activity.)
- Together, observe each component and discuss whether it is an input to photosynthesis or an output from photosynthesis. Guide the discussion by asking questions such as, "What goes into photosynthesis?" and "What does photosynthesis make for the plant?"
- Given a word bank or list of symbols (water, carbon dioxide, sunlight, oxygen, and glucose), have the students construct the reaction for photosynthesis.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

H.B.1A.4 Analyze and interpret data from informational texts and data collected from investigations, using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning, (2) support or refute hypotheses, explanations, claims, or designs, or (3) evaluate the strength of conclusions.

H.B.3A.4 (b) Identify that organisms transform food into energy that can be used.

- Students will investigate the use of sugar as food by yeast cells.
- Materials:
  - Two beakers or clear cups
  - Warm water, between 95°F and 115°F
  - Two packages of active dry yeast
  - One teaspoon of sugar
  - Two spoons for stirring
  - Two small rulers
    - Explain to the students that yeast are single-celled organisms that needs a source of energy, just like us. Students will investigate whether yeast needs a source of energy, such as sugar.

    - Label one beaker “sugar” and the other beaker “no sugar.” Add one half cup of warm water to each beaker. Add the sugar to the beaker labeled “sugar,” and add a package of yeast to each beaker. Stir each beaker and let them sit for twenty minutes.

- After twenty minutes you should observe foam in one or both beakers.
- Have the students record observations and the height of the foam every five minutes for twenty minutes. Hold a ruler to the outside of each beaker to measure the height of the foam. Note: touching the foam may cause it to collapse.
- Have the students create a line graph of the height of the foam for each beaker at each five-minute intervals.
  - The foam in the beaker labeled “sugar” should be higher than the foam in the beaker labeled “no sugar”. Explain that the yeast grows when it uses sugar as a source of energy. The bubbles are produced when the yeast gives off carbon dioxide as a waste product. The yeast in the beaker that does not have sugar does not grow as much because it does not have sugar as a source of energy.
  - For students with visual impairments, set up the investigation to provide the students with cups of yeast that have already been growing for zero, five, ten, fifteen, and twenty minutes. Have their method of tactile measurement available for them to collect the data.

Biology

Core Concept: Heredity

It is essential for students to know: DNA is a set of directions for organisms' traits. We get our DNA from our parents. (H.B.4A.1). Scientists can change DNA so that it produces beneficial traits in organisms (H.B.4B.2).

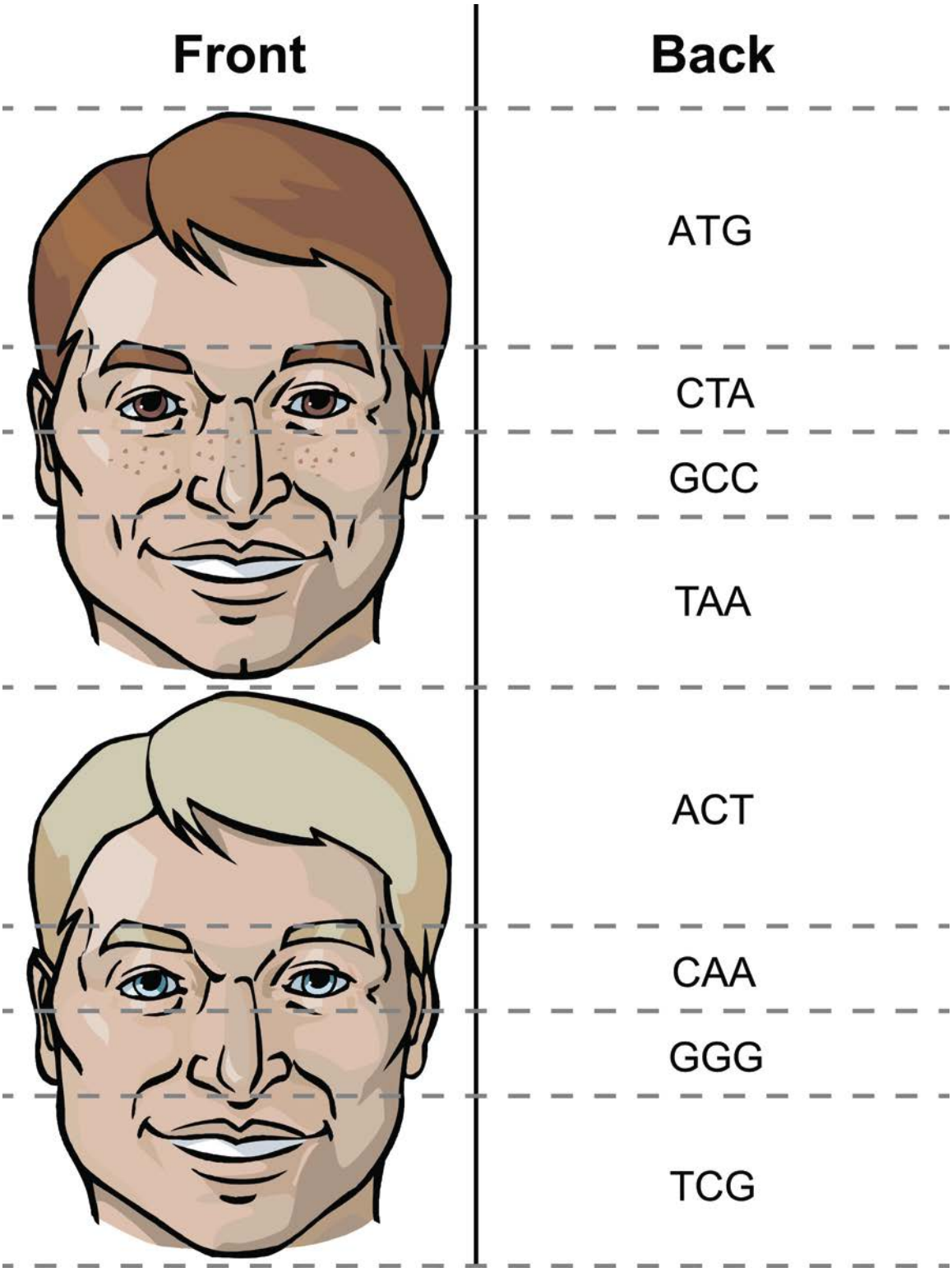
Most Complex ⟵⟶ **Least Complex**		
H.B.4A.1 (a) Identify DNA as a code for our traits.	H.B.4A.1 (b) Identify DNA as a set of directions.	H.B.4A.1 (c) Sort organisms with similar traits.
H.B.4B.2 (a) Describe how changes to DNA (directions) benefit society.	H.B.4B.2 (b) Recognize that scientists can change genetic DNA (directions) to produce beneficial traits.	H.B.4B.2 (c) Identify beneficial traits.

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

H.B.4A.1 (b) Identify DNA as a set of directions.

- Draw two different faces, each with the following traits: one with dark hair, the other with light hair; one with dark eyes, the other with light eyes; one with freckles around the nose, the other without freckles around the nose; and one with dimples around the smile, the other without dimples.

- Cut the faces into equal-sized horizontal strips that separate the hair, eyes, nose, and mouth. For example:



- On the back of each strip, write the three-letter of nucleotide bases (A, C, G, and T).

- Present the strips to the student with the bases facing upward and ask them not to turn over the strips.
- Explain to the students that DNA is a set of directions that results in different traits.
- Provide each student with a DNA code that has a three-letter combination for each trait: hair, eyes, nose, and mouth.
- Ask them to find the strips with the letters in the DNA code and order them from top to bottom so that they follow the DNA instructions.
- Have the students carefully turn over the strips and ask what traits their DNA coded. For example, a DNA code of ACT, CTA, GCC, or TCG results in a face with light hair, dark eyes, freckles, and no dimples.

<u>Activity adaptation for less complexity</u>

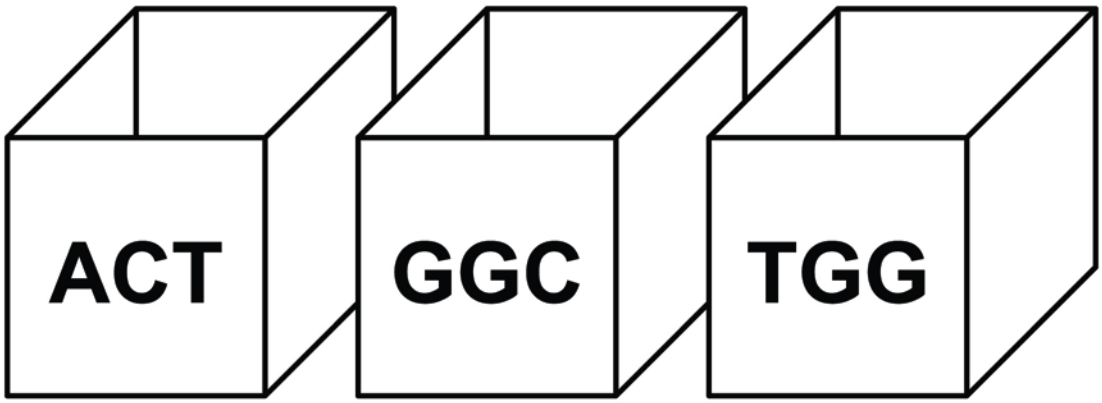
H.B.4A.1 (c) Sort organisms with similar traits.

- Give each student a single card with a face that has distinguishing traits such as hair color, eye color, and freckles.
- Ask students, "Please hold up your card if it has a face with dark hair."
  - Repeat this for each trait variation (dark hair, light hair, brown eyes, light-colored eyes, freckles, and no freckles)
- Collect all of the cards and then pass out the cards again so that each student has one or more new cards. The number of cards you choose to pass to each student is dependent on their ability to focus on or consider multiple traits.
- Have the class create groups of cards that have certain traits. For example "Let's make a pile that shows faces with light-colored eyes."
- Another option is to use actual photographs of the students.

<u>Activity adaptation for more complexity</u>

H.B.4A.1 (a) Identify DNA as a code for our traits.

- Provide each student with a DNA code that has a three-letter combination for each trait as in the middle-level activity. However, in this activity, the code should not translate into the top-down order of hair, eyes, nose, mouth, and then chin. Be sure to mix up the code so that the student has to rearrange the traits after they have collected each piece of the code.
- Have the strips with the traits and three-letter codes on the back sorted into boxes also labeled with the three-letter code.
- Have the students construct a face from their code. They should be able to sort the strips to form a face on their own.

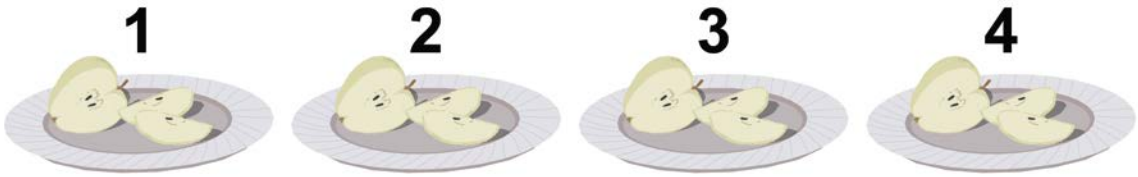


<u>Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities</u>

H.B.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.

H.B.4B.2 (b) Recognize that scientists can change genetic DNA (directions to produce beneficial traits.)

- Students will model selective breeding used by agriculturists.
- Materials:
  - Paper plates
  - A whole apple and knife to cut it in half
  - Apple seeds
  - A cup with soil to demonstrate planting the seeds
  - A chart to record results
  - Choose four samples of apples with varying texture and sweetness. There should be a mixture of sweet and tart apples in the group. Tell the students that each of the four samples is a variety of apple.
- Begin by showing the students a whole apple. Explain that this apple is bigger and sweeter than its ancestors. Farmers grew generation after generation of apples until the apples had the traits that they have today, like big and sweet. At each generation, farmers selected the apples with the best traits to produce the next generation.
- Tell the student that they are going to choose the apple traits they like best.
- Present to the students each of the four varieties of apple on a separate paper plate numbered 1-4. Tell the student that each variety of apple tastes different, and ask them to choose their favorite.



- Have the students taste each apple and vote on their favorite. Record the results in a chart.
- After the results of the first round of tasting have been recorded, show the students the whole apple cut in half with its seeds exposed. Tell students that the farmer would choose to plant the seeds of the preferred apples. Explain to them that you are going to model planting the seeds of their three favorite apples but not the seeds of the apple they liked the least.
- Model planting seeds from three favorite apples into the cups with soil and set them aside to let them “grow” overnight.
- The next day, have the three remaining apples that you “grew” the day before prepared for them to taste again. Explain that these are the apples they chose to grow again. The apple that was eliminated yesterday in not available because they chose not to replant that apple, so its traits are no longer a part of this group.
- Repeat the process of tasting, surveying the group and recording the votes, and replanting the seeds.
- On the third day, repeat the process of tasting, surveying the group and recording the votes, and replant the last, favorite apple. An example of a chart with all three rounds of tasting is shown below.

	Round 1 Votes	Round 2 Votes	Round 3 Votes
Apple on Plate #1	2	1	
Apple on Plate #2	1		
Apple on Plate #3	4	5	6
Apple on Plate #4	2	3	3

- On the fourth day, have multiple samples of the apple chosen as the favorite. Explain that this is the only variety of apple you have now. The class has modeled selective breeding of a variety of apple with the traits they prefer.

Biology

Core Concept: Biology

It is essential for students to know: Biological evolution is the framework that explains why traits change frequency within a population over time. Traits that continue through generations are ones that tend to help plants and animals survive. The concept that plants and animals with the traits best suited for survival are the ones that live and go on to reproduce is called natural selection (B-5.1). The continuity of life forms is based on an organism's success in passing genes to the next generation (B-5.2). Within a species, variability of traits leads to diversity among individuals (B-5.3). Many fields of science have contributed to the understanding of evolution. One way to understand how species evolved is through the study of fossils by paleontologists (B-5.5). Organisms can be classified based on their physical characteristics (B-5.7).

Most Complex ←		→ **Least Complex**
B-5.1 (a) Recognize that over time, populations become better adapted.	B-5.1 (b) Recognize that organisms that survive can pass on beneficial traits.	B-5.1 (c) Identify a trait that would give an organism a better chance of survival (e.g., bright colors in flowers, echolocation in bats, white fur in polar bears).
B-5.3 (a) Recognize that when the environment changes, one variation of a trait may be favored.	B-5.3 (b) Identify the variations in a trait within a species that would increase survival in a given environment (e.g., giraffes with longer necks can reach leaves on high branches).	B-5.3 (c) Identify a trait that helps a species survive (e.g., runs fast, has camouflage).
B-5.5 (a) Compare the differences between organisms found as fossils and those that are alive today.	B-5.5 (b) Match a fossil with its living counterpart through the use of pictures, picture symbols, or concrete objects.	B-5.5 (c) Identify a fossil as an organism that lived a long time ago.
B-5.7 (a) Recognize that groups of organisms with similar characteristics are related (e.g., elect two species from an array that are most closely related e.g., lion, tiger, and deer: lion and tiger are more closely related to each other than they are to a deer).	B-5.7 (b) Sort different types of organisms based on similar characteristics (e.g., sort real pictures of animals into groups that have feathers or fur).	B-5.7 (c) Identify similar characteristics between two types of organisms (e.g., alligators and dogs both have four legs, or eagles and robins both have feathers).

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

B-5.3 (b) Identify the variations in a trait within a species that would increase survival in a given environment (e.g., giraffes with longer necks can reach leaves on high branches).

- Students will observe how different traits help organisms survive in certain environments.

- Materials:
  - Two different colors of cardstock paper. Note: You will need two sheets of one color and one sheet of the other color.
  - Hole-punch
    - Scissors are optional if you choose to make dots of various sizes
  - A cup for each student
- Lay down one sheet of the cardstock.
- Use the hole-punch to create a group of dots cut out of each color of cardstock.
- Explain to the students that the dots represent the same species of insect, but the population of insects has different traits. Ask the students what is different between the groups of insects (the color).
- Place both colors of dots on the sheet of cardstock and tell the student that he or she is the predator that eats the insects.
- Note: The same number of each color of insect should be placed on the cardstock. Mix the colors of dots prior to placing on the cardstock so that not all of one color is in the same location.
- Give the student ten seconds to pick up as many insects as he or she can with their fingers, one at a time, and place them into a cup. Note: Students may also use forceps, or tweezers, to pick up the insects.
- At the end of ten seconds, sort the insects in the cup by their trait. Then sort the "surviving" (i.e. those remaining on the cardstock) insects by trait.
- Ask the students which trait helps this species of insect survive (having a color that is the same color as the cardstock).
- For students with visual impairments, textured dots such as felt on a felt background and pom-poms that stand out against the felt background. For students with fine motor impairments, they may point to a dot one at time for the teacher to pick up. Dots can also be created using a scrapbooking punch to create larger dots.
- Discuss with the students which insects were easier to capture and why. (The dots that are a different color than the cardstock are easier to capture because they stand out more against the background.) Then ask the students which trait helps this species of insect survive. (Having a coloration similar to the cardstock because they are better camouflaged.)

<u>Activity adaptation for less complexity</u>

B-5.3 (c) Identify a trait that helps a species survive (e.g., runs fast, has camouflage).

- Explain to the students that the dots represent the same species of insect, but the population of insects has different traits. Some bugs are white, and others are gray with black specs.
- Place the dots onto the newspaper and explain that some of the bugs are better camouflaged in their environment than others.
- Ask the students to distinguish between the bugs that are camouflaged and the bugs that are not camouflaged. Which bugs are easier to see?
- Follow up with another question. Why is it better to be camouflaged? If you were a bird that eats these bugs, which would be easier for you to capture?

Activity adaptation for more complexity

B-5.3 (a) Recognize that when the environment changes, one variation of a trait may be favored.

- Begin by completing the activity at the middle level, but discard the insects that were collected in the cup and keep the "surviving insects."
- Provide white paper that matches the white dots. Explain to the student that the white paper represents a change to the environment.
- Have the student predict what will happen to the population of surviving insects in this new environment.
- Place the bugs onto the white paper that represents the new environment and give the student ten seconds to pick up as many insects as he or she can, one at a time, and place them into a cup.
- At the end of ten seconds, sort the surviving insects by traits.
- Ask the students what kinds of traits help this species of insects survive in this new environment.
- How did the change in the environment impact this population of insects?
- Emphasize the idea that the best trait for survival depends on the environment.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

H.B.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

B-5.5 (b) Match a fossil with its living counterpart through the use of pictures, picture symbols, or concrete objects.

- Students will observe how things in their daily life have changed over time and compare this to how organisms change over time.
- Materials:
  - An image of an old model of a car and a new car
  - An image of an old telephone and a cell phone
  - An image of a mammoth and elephant
  - Images of other extinct organisms and their modern relatives
- Present to the students an image of an old car and a new car. Explain that the older type of car is no longer around, and discuss their similarities and differences.
- Then present to the students an image of an old phone and a cellular phone. Discuss the similarities and differences between the phones.
- Now ask the students if they think animals change over time.

- Present to the students an image of a mammoth, and explain that there are no more mammoths today (“extinct”). Have them choose from an array of other modern organisms which of the animals are similar to (or might be related to) the mammoth the same way the modern car is similar to (or might be related to) the older car (organism options may include: elephant, shark, whale, lion).
- Discuss the similarities and differences between the mammoth and the elephant.
- Continue presenting images of other extinct organisms such as megalodon, ancient whales, and smilodon and have students select the modern organisms that share their ancestry (shark, modern whale, lions, respectively).
  - Discuss the similarities and difference between each pair of organisms.

Biology

Core Concept: Ecosystem Dynamics

It is essential for students to know: A population is a group of organisms belonging to the same species that live in a particular area. The size of a population is affected by many factors (H.B.6A.2). Plants and animals rely on each other through the exchange of oxygen and carbon dioxide (H.B.6B.1). Homeostasis of an ecosystem is the ecosystem's ability to remain unchanged over time in spite of biotic (living) and abiotic (nonliving or chemical) factors. While homeostasis is possible, ecosystems often change over time as a result of these biotic and abiotic factors (H.B.6C.1). Ecosystems can also be affected by human activities. These activities can have a positive or a negative effect on the Earth (H.B.6D.1).

Most Complex ⟷		**Least Complex**
H.B.6A.1 (a) Describe how a habitat changes when a population changes (availability of resources).	H.B.6A.1 (b) Identify whether a population increases or decreases as a result of a change in the ecosystem (e.g., because the weather is colder, many birds moved away; as a result, consider whether the bird population would increase or decrease).	H.B.6A.1 (c) Identify factors that can impact the survival of a population.
H.B.6B.1 (a) Recognize both plants and animals use cellular respiration that produces carbon dioxide, and plants use photosynthesis when producing oxygen.	H.B.6B.1 (b) Follow the exchange to show that oxygen produced by plants is used by animals and carbon dioxide produced by animals is used by plants.	H.B.6B.1 (c) Recognize that plants produce oxygen and animals produce carbon dioxide.
H.B.6C.1 (a) Summarize how a change in a nonliving factor can affect the environment and can, in turn, affect the populations living in an environment.	H.B.6C.1 (b) Identify the effect that a change in a nonliving environmental factor could have on particular populations (e.g., too little rain would not allow most plants to grow and animals would have to leave the environment to find water).	H.B.6C.1 (c) Identify a nonliving environmental factor (e.g., water) that could change (e.g., flooding) and affect a population (e.g., organisms would have to seek a new environment).
H.B.6D.1 (a) Categorize human activities as positive or negative on the basis of their effect on the Earth.	H.B.6D.1 (b) Match human activities with their effect on the Earth.	H.B.6D.1 (c) Identify human activities that can affect the Earth (e.g., cutting trees can eliminate habitats, recycling can save resources).

<u>Application of Performance Indicators at the Middle Level—Instructional Activities</u>

H.B.6D.1 (b) Match human activities with their effect on the Earth.

- Students will identify the cause and effect of waste, pollution, and loss of habitat.

- Begin with a discussion about waste, pollution, and loss of habitat, and talk about how humans cause these things.
  - One way to demonstrate the effects of waste might be to empty a trash can onto the floor. Now the classroom is messy.
- Explain to the students that you are going to talk about different human activities, and they will decide if these activities cause new waste, pollution, or loss of habitat.
  - The following are suggestions of human activities. The instructor may choose other activities relevant to the students' daily experiences such as litter in the school garden.
    - Driving a car: Does this cause more air pollution than walking or does it prevent air pollution?
    - Recycling: Does this cause more waste or does it prevent waste than not recycling?
    - Planting trees: Does this give birds a place to live or does it remove their place to live?
    - Building a parking lot: Does this create more habitat or reduce habitat than leaving the land as it was?
    - Littering: Does this cause more soil pollution or less soil pollution than not littering?

<u>Activity adaptation for less complexity</u>

H.B.6D.1 (c) Identify human activities that can affect the Earth (e.g., cutting trees can eliminate habitats, recycling can save resources).

- Present to the students before and after images of environments and scenarios.
- Discuss what is different between the images and then decide if the change is good or bad.
  - Examples may include:
    - A picture of a forest and a picture of the trees cut down
    - A parking lot and a newly planted forest
    - A littered park and a park with no litter
    - Someone littering and someone recycling

<u>Activity adaptation for more complexity</u>

H.B.6D.1 (a) Categorize human activities as positive or negative on the basis of their effect on the Earth.

- Students will decide which human activity is better by discussing the advantages and disadvantages of the activity.
- Begin by discussing planting trees or cutting down trees. Which activity is better?
- Then have the students come up with advantages for having trees (for example, trees provide a place for animals to live), and have them come up with disadvantages of cutting down trees (birds no longer have a place to live).
- Create a poster, write onto the board, or complete closed sentences to record the students' responses.
- Continue by presenting the students with activities they engage in every day, such as recycling or walking to school.

Investigative Application of Science and Engineering Practice Performance Indicators at the Middle Level—Instructional Activities

H.B.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses based on credible scientific information, (2) identify materials, procedures, and variables, (3) use appropriate laboratory equipment, technology, and techniques to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

H.B.6B.1 (b) Follow the exchange to show that oxygen produced by plants is used by animals and carbon dioxide produced by animals is used by plants.

- Students will observe the production of CO_2 from respiration and oxygen from photosynthesis.
- This investigation may be diagramed or explored through similar online, virtual labs on a Smart Board in lieu of the hands-on investigation. (An example of a virtual lab can be found here: https://www.classzone.com/books/hs/ca/sc/bio_07/virtual_labs/virtualLabs.html)
  - Note that the pondweed, *Elodea* is more often used to demonstrate this concept along with a snail. However, the possession, importation, or distribution of *Elodea* is illegal in South Carolina due to the invasive nature of the species.
- Materials:
  - Two test tubes with corks
  - Tap water
  - Bromothymol Blue
  - A straw
  - A lamp
  - Two pieces of *Cabomba* plant
  - Aluminum foil
- Begin by explaining to the students that organisms breathe in oxygen and exhale (breathe out) carbon dioxide. Plants take in carbon dioxide and produce oxygen during photosynthesis.
- Add tap water, a piece of *Cabomba*, and one mL of Bromothymol Blue to both test tubes.
- Using a straw, blow bubbles in both test tubes until the liquid turns yellow.
- Explain to the students that the carbon dioxide that you exhaled into the water causes the blue chemical in the water to turn yellow. Adding oxygen to the water would cause it to return to a blue or green color.
- Cover one test tube with aluminum foil. This will be the control. If plants do not have access to light, they will not photosynthesize and produce oxygen.
- Place the other test tube under the lamp.
- Ask the students what will happen to each test tube after twenty-four hours. Record the students' predictions.

- After twenty-four hours, have the students record their observations in the following table:

Test Tube	Initial Color	Color after 24 Hours
Test Tube 1: Covered in aluminum	Yellow	*Yellow*
Test Tube 2: Placed under lamp	Yellow	*Blue/Green*

- Ask the students if their prediction was correct.
- What happened in Test Tube 2? Explain that the plant produced oxygen from photosynthesis, turning the water blue or green.
- Optional: Explain to the students that plants also use cellular respiration. Therefore, in Test Tube 1, the plant was continuing to respire and produce carbon dioxide, which would keep the water yellow.