SOUTH CAROLINA
DEPARTMENT OF EDUCATION

# Bundling Guide for Grade 4 Science

**Purpose and Use**

This document is intended to be a guide to provide examples of ways Performance Expectations (PEs) could be bundled. For this purpose, a bundle as defined by Pruit (2014), is, "a set of PEs that provide students with coherent connections among concepts within and across disciplines." This document is not intended to be read from cover to cover, but to be used, when needed, to support teacher professional learning and curriculum decisions. This is not intended for student use, and thus is not written in student-friendly language. This is not a curriculum or a means to limit instruction in the classroom. The bundles presented in this guide are not ordered for instruction. Although each PE states a dedicated Science and Engineering Practice (SEP) and Crosscutting Concept (CCC), students will need to use the full range of SEPs and CCCs to achieve success by the end of instruction.

The bundles in this document do not represent the only way the PEs can be bundled. PEs bundled together may change depending upon the selected anchoring phenomenon that students are working to explain. The bundles presented in this guide were developed using an iterative process informed by the work of Krajick and colleagues (2014). This process is summarized in the steps below:

1. Review bundles that already exist.
2. Build bundles around an anchoring phenomenon.
    a. The "Example anchoring phenomena to support 3D instruction" provided in this resource is just that, an example. There are myriad phenomena to support 3D instruction, and different phenomena may be more appropriate for different learning contexts.
3. Explore and look for unexpected relationships among the PEs, including bundling across disciplines (Earth and Space Science, Life Science, Physical Science) when appropriate. This can include identification of PEs that are only partially met in the bundle.
    a. PEs within a bundle marked with an asterisk (*) share an authentic connection with the bundle but may not fully met.
4. Make sure each PE in the grade/course is found in at least one bundle.

**Energy and Motion**

Objects move when forces act on them, and energy is transferred. The faster an object moves, the more energy it has. When two objects collide, energy is transferred from one to another. Usually, a slower or stationary object will move in the direction of a faster-moving object after a collision. For example, if a ball rolls down ramps of different heights and hits a stationary block, the block will move different distances depending on the ball's speed and mass. When objects hit each other, some of the energy causes the air around them to vibrate. These vibrations happen because the collision heats the air, and that moving air is interpreted as sound. The surface also affects motion. On a rough surface, friction slows objects down more than on a smooth surface because more energy is converted to heat. In materials like water or rope, energy from a force can also create visible waves. These waves have patterns, such as height (amplitude) and spacing (wavelength), that can be observed and measured. These patterns of motions and energy can be observed and measured to make predictions and develop explanations about their relationships.

**PEs aligned to this bundle:**

- 4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.
- 4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.
- 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. *
- 4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that can cause objects to move. *

**Example anchoring phenomena to support 3D instruction:**

- Placing salt, powder, and/or sand on a sound speaker
- Newton's Cradle
- Tohoku Earthquake and Tsunami

**Energy Transfer and Conversion**

Energy is transferred from place to place by motion, light, sound, and electric current. When energy is changed from one form to another, it has been converted. For example, an electric current in a house can be used to power a lamp. When the lamp is turned on, the light bulb converts that electric current into light. Some of that light energy is also converted into heat energy, making the light bulb and the air around it feel warm. Light energy can be transferred long distances between energy conversions. For example, cell phones convert sound waves into digital signals (a form of light energy) for transmission. Then, the digital signal is converted back into sound waves, allowing two people to talk across great distances.

**PEs aligned to this bundle:**

- 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
- 4-PS4-3. Generate and compare multiple solutions that use patterns to transmit information. *

**Example anchoring phenomena to support 3D instruction:**

- Parallel versus series circuits
- Tracking Great White Sharks
- Bluetooth trackers

**Plants and Animals: Structures and Processes**

Animals and plants have specialized structures, both internal and external, that support their growth, reproduction, survival, and behavior. Plants' external structures provide support, aid in reproduction, and offer protection from the environment. While plant internal structures are simpler than those of animals, the internal structures of flowers play an important role in reproduction. The most complex animal structures are their sense receptors, which are specialized to detect particular kinds of information. This information may be processed by the animal's brain. Animals use both stimuli and memories to respond to their environment, often through coordinated actions involving internal and external structures. For example, when light reflects off of prey and enters a predator's eye, that stimulus is processed, allowing the predator to respond and complete a successful hunt.

**PEs aligned to this bundle:**

- 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function together in a system to support growth, behavior, and reproduction.
- 4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.
- 4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. *

**Example anchoring phenomena to support 3D instruction:**

- Eye location of a coyote versus a chipmuck
- Red-tailed hawk's eyesight
- Solar tracking of sunflowers

**Earth's Change Over Time**

Earth's surface is constantly changing. Geologists, scientists who study Earth systems use patterns to explain how, where, and when these changes occur. Rock formations and fossils found in layers of rock (stratigraphic columns) provide evidence of how landscapes have changed over time. For example, a rock layer containing marine shell fossils above a layer with plant fossils and no shells suggests a change from land to water over time. On a larger scale, Earth features like mountain ranges, ocean trenches, continental boundaries, and others often occur in patterns. These features can be compared with patterns of Earth processes like earthquakes and volcanoes to reveal relationships between Earth's surface and the forces that shape it. Weather, in particular, affects many Earth features. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around. The result of these processes can often be observed on topographic maps. Liquid water can change Earth's surface in many ways, from cutting river valleys to shaping coastlines with ocean waves.

**PEs aligned to this bundle:**

- 4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
- 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate or erosion by water, ice, wind, or vegetation.
- 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.
- 4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. *

**Example anchoring phenomena to support 3D instruction:**

- Earthquake and tsunami patterns over time
- Marine fossils in the Grand Canyon

**Human Energy Needs**

All materials, especially energy and fuels, that people use come from natural sources, and their use affects the environment. Some natural resources are renewable, and some are not. People have developed technologies to capture energy from renewable sources, such as wind and sunlight, and convert it into more usable forms like electrical energy or heat. However, many non-renewable resources, including fossil fuels and nuclear materials, are used to meet individual and community energy needs. The extraction and use of natural resources impact the environment, and no technology is perfect. As people make decisions about which resources to use, they must consider both the positive and negative effects on the environment and society.

**PEs aligned to this bundle:**

- 4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and how their uses affect the environment.
- 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. *
- 4-PS3-4. Apply scientific ideas to design, test, and refine a device the converts energy from one form to another. *

**Example anchoring phenomena to support 3D instruction:**

- Wind turbines in wildlife habitats
- Gas-powered generators vs solar chargers
- Solar panel farms

**Humans and Natural Hazards**

A variety of hazards to individuals and communities are the result of Earth processes, such as earthquakes, tsunami, volcanic activity, and others. By carefully recording and analyzing patterns in these events, people can make informed predictions about when and where they may occur. For example, ocean tides influence the design of coastal structures to protect property, and warning systems can communicate information about dangers like rip currents or unusually high tides. Some hazards, like earthquakes, are less predictable and require long term planning, such as using base isolation techniques when constructing buildings in high-risk areas. Although people cannot eliminate natural hazards, they can prepare for them and take steps to protect themselves and their communities.

**PEs aligned to this bundle:**

- 4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
- 4-PS4-3. Generate and compare multiple solutions that use patterns to transmit information. *
- 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. *
- 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. *

**Example anchoring phenomena to support 3D instruction:**

- Rockslides on Interstate 40
- Red flag warnings from the Forestry Service