SC DEPARTMENT OF EDUCATION

Bundling Guide for Grade 8 Science

Office of Assessment and Standards

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 whole 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.

Contact Interactions

Newton's third law says that whenever one object pushes or pulls on another, the second object pushes or pulls back with the same force but in the opposite direction. When describing forces, both magnitude and direction are required. For example, if you push against a wall, the wall “pushes back” with the same force. An object’s motion depends on all the forces acting on it. Motion occurs when the distance between two objects, or the observer, is increasing or decreasing. This requires a reference point. When the net force(s) acting upon an object does not equal zero, the object will change direction, speed up, or slow down. An object with greater mass will require more force to change its direction or speed. If there's a net force (meaning the forces don't cancel each other out), the object's motion will change. The more mass an object has, the more force it takes to change its motion, and if a larger force is applied to an object, it will experience a larger change in motion. Inertia is the tendency of an object to resist changes in its motion.

PEs aligned to this bundle:

- 8-PS2-1. Apply Newton’s third law to design a solution to a problem involving the motion of two colliding objects.
- 8-PS2-2. Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.

Example anchoring phenomena to support 3D instruction:

- How can an astronaut return to their rocket if they become untethered?
- Flight (birds, planes, helicopters)
- Seat belt safety

Distance Interactions

Electric and magnetic forces, which together form electromagnetic forces, can either attract or repel objects. The strength of these forces depends on the amount of charge, current, or magnetic strength involved, as well as how far apart the objects are. These forces don't require objects to touch each other to act. Instead, they are explained by fields that extend through space. For example, a charged object creates an electric field around it, while a magnet generates a magnetic field. These fields can influence other charged or magnetic objects nearby, causing them to be attracted or repelled. The strength of the gravitational force, however, is determined by the masses of the objects interacting and the distance between them. Larger masses or shorter distances result in stronger gravitational forces between objects.

PEs aligned to this bundle:

- 8-PS2-3. Analyze and interpret data to determine the factors that affect the strength of electric and magnetic forces
- 8-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
- 8-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects and the distance between them.*

Example anchoring phenomena to support 3D instruction:

- Magnetic slime
- Electromagnetic rollercoaster

Interactions of the Earth, Sun, and Moon

Humans can observe and understand the apparent movements of the Sun, Moon, and stars in the sky using models. These models help predict and explain phenomena like moon phases, tides, as well as solar and lunar eclipses. Earth's axis is tilted relative to its orbit around the Sun, which causes the changing seasons throughout the year. This tilt affects how sunlight hits different parts of the Earth. Gravitational forces, which depend on the masses and distances between objects, play a crucial role in shaping the universe. They govern the evolution and movement of large-scale structures like galaxies and star systems.

PEs aligned to this bundle:

- 8-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, tides, and seasons.
- 8-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects and the distance between them.*

Example anchoring phenomena to support 3D instruction:

- Sun-Earth-Moon System
- Sundials
- Tidal flooding during natural disasters

Structures and Motion in the Universe

Our planet, along with the rest of the solar system, is part of the Milky Way galaxy, which is just one of countless galaxies in the universe. The solar system consists of the Sun, planets, moons, and other celestial objects orbiting around the Sun due to its gravitational pull. Scientists propose that the solar system formed from a rotating disk of gas and dust that coalesced as particles collided and accreted, eventually forming the Sun and its orbiting planets. Gravitational forces, which depend on the masses and distances between objects, play a crucial role in shaping the universe. They govern the evolution and movement of large-scale structures like galaxies and star systems.

PEs aligned to this bundle:

- 8-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects and the distance between them.
- 8-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
- 8-ESS1-3. Evaluate information to determine scale properties of objects in the solar system.

Example anchoring phenomena to support 3D instruction:

- Cavendish Experiment
- Gravitational Waves and LIGO
- How can we protect Earth from asteroids?

Wave Modeling and Applications

A basic wave is a repeating pattern with specific properties like wavelength, frequency, and amplitude. When signals are digitized, converting them into wave pulses, it provides a more dependable method for encoding and transmitting information.

PEs aligned to this bundle:

- 8-PS4-1. Using mathematical representations, describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave
- 8-PS4-3. Communicate information to support the claim that digital devices are used to improve our understanding of how waves transmit information.
- 6-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.[1]

Example anchoring phenomena to support 3D instruction:

- Vinyl records have higher sound quality that CD/MP3
- Ocean soundscapes
- Communication with Mars rover (connection to Interactions of the Earth, Sun and Moon and Structures and Motion in the Universe)

[1]To facilitate the student understanding necessary to successfully achieve the PE 8-PS4-3, students will need a working understanding of the electromagnetic spectrum, including frequency, wavelength, and wave speed. Students will need a working understanding of the electromagnetic spectrum to be able to explain the wave behavior utilized by digital devices. This conflicts with the State Assessment boundary for PE 8-PS4-1. The electromagnetic spectrum is introduced through PE 6-PS4-2.

Growth, Reproduction, and Inheritance

Animals have behaviors that help them reproduce, while plants use different methods for reproduction, sometimes relying on animals and special features. Both genetic factors and local conditions affect how plants grow, while an animal's growth is influenced by genetics, food, and interactions with other organisms. Each species has a usual size range for adults. Organisms reproduce either sexually or asexually, passing genetic information to their offspring. Offspring inherit variations in traits due to genetic differences between parents and offspring. In sexual reproduction, each parent contributes half of the offspring's genes, randomly selected from their own set. Offspring inherit two versions of each gene, which may be the same or different. In asexual reproduction, offspring are genetic copies of the parent. These genes are found in chromosomes within cells and determine the traits of an organism by controlling the production of specific proteins. Changes or mutations in genes can alter proteins, affecting the structure and function of the organism, and its traits. Under specific conditions, some mutations are helpful, some harmful, and others have no effect. Humans can influence the traits of organisms through artificial selection, where desired traits are chosen based on genes and passed to offspring through selective breeding.

PEs aligned to this bundle:

- 8-LS1-4. Use arguments, based on empirical evidence and scientific reasoning, to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
- 8-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- 8-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
- 8-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
- 8-LS4-5. Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms.
- 8-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individual’s probability of surviving and reproducing in a specific environment.*

Example anchoring phenomena to support 3D instruction:

- Domestic animal species
- Domestic plant species
- Golden rice

Changes in Species Over Time

The fossil record is a collection of fossils arranged in chronological order, often based on where they are found in sedimentary layers or through methods like radioactive dating. This provides a historical account of life on Earth, showing how species have evolved, diversified, and sometimes gone extinct over time. By comparing the anatomical features of modern organisms and fossils, scientists can reconstruct evolutionary relationships and infer the history of life. Natural selection, a process where advantageous traits become more common in a population over generations, is a major driver of evolution. Traits that improve an organism's chances of survival and reproduction in a particular environment are favored, leading to changes in the population's characteristics over time. Humans also play a role in influencing traits through artificial selection, where desirable traits are chosen through selective breeding. This allows specific genetic traits to be passed down to offspring, shaping the characteristics of domesticated plants and animals.

PEs aligned to this bundle:

- 8-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operated in the past as they do today.
- 8-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer their ancestral relationships.
- 8-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individual’s probability of surviving and reproducing in a specific environment
- 8-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
- 8-LS1-4. Use arguments, based on empirical evidence and scientific reasoning, to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.*
- 8-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.*
- 8-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.*

Example anchoring phenomena to support 3D instruction:

- North American Megafauna
- Sirenian (sea cow) evolution

References

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