Next Gen PET

Teaching and Learning Extension A

Reading: The Next Generation Science Standards and Next Gen PET

Purpose

In this extension activity you will learn about the Next Generation Science Standards (NGSS) and how they are related to the content you will be learning in Next Gen PET.

The Next Generation Science Standards (NGSS) describe what children in grades K-12 should be able to do at the conclusion of specific grade levels. These standards are written as *Performance Expectations* that draw on three types of knowledge: *1) Disciplinary Core Ideas, 2) Science and Engineering Practices,* and *3) Crosscutting Concepts.* This reading will help you become familiar with the NGSS.

Performance Expectations

Read through the example performance expectations below. Each includes a label of the form K-PS2-1. The first letter indicates the grade level. The "K" in K-PS2-1 indicates that it is a Kindergarten performance expectation. The next alphanumeric group indicates the discipline (PS is Physical Science), core idea, and sub-idea.

K-PS2-1	Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
3-PS2-1	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
3-PS2-4	Define a simple design problem that can be solved by applying scientific ideas about magnets.
1-PS4-3	Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.
1-PS4-4	Use tools and materials to design and build a devise that uses light or sound to solve the problem of communicating over a distance.

Notice that these expectations are written as things that students *do*, not what they *know* and *understand.* Yet, for each of these performance expectations students must have developed some conceptual understanding. Even at the kindergarten level, K-PS2-1, asks students to plan an investigation that

compares the effects of different strengths or directions of pushes on an objects motion. To do this, they must have an understanding of pushes and strength of pushes as well as the ways that an object might move in order to develop an appropriate test.

Disciplinary Core Ideas

There are four physical science ideas in the NGSS, each with 3-4 sub ideas:

PS1. Matter and Its Interactions
- PS1A. Structure and Properties of matter
- PS1B. Chemical Reactions
- PS1C. Nuclear Processes

PS2. Motion and Stability: Forces and Interactions
- PS2A. Forces and Motion
- PS2B. Types of Interactions
- PS2C. Stability and Instability in Physical Systems

PS3. Energy
- PS3A. Definitions of Energy
- PS3B. Conservation of Energy and Energy Transfer
- PS3C. Relationships between Energy and Forces
- PS3D. Energy and Chemical Processes in Everyday Life

PS4. Waves and Their Applications in Technology for Information Transfer
- PS4A. Wave Properties
- PS4B. Electromagnetic Radiation
- PS4C. Information Technologies and Instrumentation

As you work through the units and activities in Next Gen PET, you should be able to see how your work is related to the four large ideas above. Take a look at the table of contents for the module(s) or unit(s) you will be completing and try to match the disciplinary core ideas above with activities in Next Gen PET that you anticipate will address these disciplinary core ideas.

Science and Engineering Practices

The Next Generation Science Standards (NGSS) describe eight practices of science and engineering. These are things that scientists and engineers do when they are doing science. Below is a list of the practices (NRC, 2012). The goals of science and engineering are different. The goal of science is to explain natural phenomenon and to support these explanations with evidence. The goal of engineering is to identify problems that humans face and to solve

these problems through the invention and development of objects or processes. The processes by which these goals are met are similar.

1. Asking questions (for science) and defining problems (for engineering).
2. Developing and using models.
3. Planning and carrying out investigations.
4. Analyzing and interpreting data.
5. Using mathematics and computational thinking.
6. Constructing explanations (for science) and designing solutions (for engineering).
7. Engaging in argument from evidence.
8. Obtaining, evaluating, and communicating information.

Next Gen PET is designed so that as you learn about physics and perhaps chemistry in this course, you will also be engaging in some of the science and engineering practices. Some of these practices will be used throughout the entire course and others you will see used in a more focused way in specific units or modules.

Crosscutting Concepts

The third strand of the Next Generation Science Standards is the crosscutting concepts. The crosscutting concepts are ideas that bridge the disciplines of science. This means that these ideas cross not only topics in physical science (e.g., "magnetism" and "pressure") but across life, earth, and space sciences.

The seven crosscutting concepts are listed below, along with a brief description of each.

1. Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

2. Cause and effect. Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

3. Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy, and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

4. Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

5. Energy and matter. Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

6. Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study

References

National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: The National Academies Press.

Achieve (2012). *Next Generation Science Standards.* Available at http://www.nextgenscience.org/