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.

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

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
comparis the effects of different strengths or directions of pushes on an object's 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 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 are the crosscutting concepts. These are ideas that bridge the science disciplines. While we do not explicitly focus on crosscutting concepts in Next Gen PET, you may notice that the ideas come up in both the Physics and Chemistry Modules. There are seven crosscutting concepts:

1. Patterns
2. Cause and Effect: Mechanism and explanation,
3. Scale, proportion, and quantity,
4. Systems and system models,
5. Energy and matter: Flows, cycles, and conservation
6. Structure and function, and
7. Stability and change.

**References**
