

## 4.Waves: Waves and Information

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Students who demonstrate understanding can:

- 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.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]
- 4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.\*** [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> <li>Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> <li>Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)</li> </ul> <p style="text-align: center;">----- <b>Connections to Nature of Science</b> -----</p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Science findings are based on recognizing patterns. (4-PS4-1)</li> </ul>	<p><b>PS4.A: Wave Properties</b></p> <ul style="list-style-type: none"> <li>Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (<i>Note: This grade band endpoint was moved from K–2.</i>) (4-PS4-1)</li> <li>Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)</li> </ul> <p><b>PS4.C: Information Technologies and Instrumentation</b></p> <ul style="list-style-type: none"> <li>Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)</li> </ul> <p><b>ETS1.C: Optimizing The Design Solution</b></p> <ul style="list-style-type: none"> <li>Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (<i>secondary to 4-PS4-3</i>)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)</li> <li>Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)</li> </ul> <p style="text-align: center;">----- <b>Connections to Engineering, Technology, and Applications of Science</b> -----</p> <p><b>Interdependence of Science, Engineering, and Technology</b></p> <ul style="list-style-type: none"> <li>Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)</li> </ul>
<p><i>Connections to other DCIs in fourth grade: 4.PS3.A (4-PS4-1); 4.PS3.B (4-PS4-1); 4.ETS1.A (4-PS4-3)</i></p> <p><i>Articulation of DCIs across grade-levels: K.ETS1.A (4-PS4-3); 1.PS4.C (4-PS4-3); 2.ETS1.B (4-PS4-3); 2.ETS1.C (4-PS4-3); 3.PS2.A (4-PS4-3); MS.PS4.A (4-PS4-1); MS.PS4.C (4-PS4-3); MS.ETS1.B (4-PS4-3)</i></p>		
<p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy –</i></p> <p><b>RI.4.1</b> Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (<i>4-PS4-3</i>)</p> <p><b>RI.4.9</b> Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)</p> <p><b>SL.4.5</b> Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (<i>4-PS4-1</i>)</p> <p><i>Mathematics –</i></p> <p><b>MP.4</b> Model with mathematics. (<i>4-PS4-1</i>)</p> <p><b>4.G.A.1</b> Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (<i>4-PS4-1</i>)</p>		

\*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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