

# New York State P-12 Science Learning Standards

## 4. Waves: Waves and Information

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;">-----</p> <p style="text-align: center;"><i>Connections to Nature of Science</i></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. (secondary to 4-PS4-3)</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 (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;">-----</p> <p style="text-align: center;"><i>Connections to Engineering, and Applications of Science</i></p> <p><b>Interdependence of Science, Engineering, 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>

*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)

*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**

*New York State Next Generation Learning Standards Connections:*

*ELA/Literacy—*

**4R1** Locate and refer to relevant details and evidence when explaining what a text says explicitly/implicitly and make logical inferences. (4-PS3-1)

**4SL5** Include digital media and/or visual displays in presentations to emphasize central ideas or themes. (4-PS4-1)

*Mathematics—*

**MP.4** Model with mathematics. (4-PS4-1)

**NY-4.G.1** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-1)

\*Connection boxes updated as of September 2018

\*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The text in the "Disciplinary Core Ideas" section is reproduced verbatim from *A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas* unless it is preceded by (NYSED).

# New York State P-12 Science Learning Standards

## 4. Structure, Function, and Information Processing

Students who demonstrate understanding can:

- 4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.** [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]
- 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]
- 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.** [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

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 to describe phenomena. (4-PS4-2)</li> <li>▪ Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)</li> </ul> <p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <ul style="list-style-type: none"> <li>▪ Construct an argument with evidence, data, and/or a model. (4-LS1-1)</li> </ul>	<p><b>PS4.B: Electromagnetic Radiation</b></p> <ul style="list-style-type: none"> <li>▪ An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)</li> </ul> <p><b>LS1.A: Structure and Function</b></p> <ul style="list-style-type: none"> <li>▪ Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)</li> </ul> <p><b>LS1.D: Information Processing</b></p> <ul style="list-style-type: none"> <li>▪ Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>▪ Cause and effect relationships are routinely identified. (4-PS4-2)</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>▪ A system can be described in terms of its components and their interactions. (4-LS1-1), (LS1-2)</li> </ul>
<p><i>Connections to other DCIs in fourth grade:</i> N/A</p>		
<p><i>Articulation of DCIs across grade-levels:</i> <b>1.PS4.B</b> (4-PS4-2); <b>1.LS1.A</b> (4-LS1-1); <b>1.LS1.D</b> (4-LS1-2); <b>3.LS3.B</b> (4-LS1-1); <b>MS.PS4.B</b> (4-PS4-2); <b>MS.LS1.A</b> (4-LS1-1),(4-LS1-2); <b>MS.LS1.D</b> (4-PS4-2),(4-LS1-2)</p>		
<p><i>New York State Next Generation Learning Standards Connections:</i></p> <p><b>ELA/Literacy</b>–</p> <p><b>4W1</b> Write an argument to support claim(s), using clear reasons and relevant evidence. (4-LS1-1)</p> <p><b>4SL5</b> Include digital media and/or visual displays in presentations to emphasize central ideas or themes. (4-PS4-2),(4-LS1-2)</p> <p><b>Mathematics</b>–</p> <p><b>MP.4</b> Model with mathematics. (4-PS4-2)</p> <p><b>NY-4.G.1</b> Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-LS1-1)</p> <p><b>NY-4.G.3</b> Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (4-PS3-4)</p> <p>*Connection boxes updated as of September 2018</p>		

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# New York State P-12 Science Learning Standards

## 4. Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

- 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.** [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; tilted rock layers indicate past crustal movement; glacial scratches on rock formations indicating glacier movement; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]
- 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.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water and/or loose Earth materials due to gravity, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]
- 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]
- 4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.\*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.]

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>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>▪ Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)</li> </ul> <p><b>Analyzing and Interpreting Data</b> Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</p> <ul style="list-style-type: none"> <li>▪ Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)</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>▪ Identify the evidence that supports particular points in an explanation. (4-ESS1-1)</li> <li>▪ Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)</li> </ul>	<p><b>ESS1.C: The History of Planet Earth</b></p> <ul style="list-style-type: none"> <li>▪ Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)</li> </ul> <p><b>ESS2.A: Earth Materials and Systems</b></p> <ul style="list-style-type: none"> <li>▪ Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1)</li> </ul> <p><b>ESS2.B: Plate Tectonics and Large-Scale System Interactions</b></p> <ul style="list-style-type: none"> <li>▪ The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)</li> </ul> <p><b>ESS2.E: Biogeology</b></p> <ul style="list-style-type: none"> <li>▪ Living things affect the physical characteristics of their regions. (4-ESS2-1)</li> </ul> <p><b>ESS3.B: Natural Hazards</b></p> <ul style="list-style-type: none"> <li>▪ A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.)</li> </ul> <p><b>ETS1.B: Designing Solutions to Engineering Problems</b></p> <ul style="list-style-type: none"> <li>▪ Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>▪ Patterns can be used as evidence to support an explanation. (4-ESS1-1),(4-ESS2-2)</li> </ul> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>▪ Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1),(4-ESS3-2)</li> </ul> <hr/> <p style="text-align: center;"><i>Connections to Engineering, Technology, and Applications of Science</i></p> <hr/> <p><b>Influence of Engineering, Technology, and Science on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>▪ Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)</li> </ul> <hr/> <p style="text-align: center;"><i>Connections to Nature of Science</i></p> <hr/> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b></p> <ul style="list-style-type: none"> <li>▪ Science assumes consistent patterns in natural systems. (4-ESS1-1)</li> </ul>

*Connections to other DCIs in fourth grade: 4.ETS1.C (4-ESS3-2)*

*Articulation of DCIs across grade-levels: K.ETS1.A (4-ESS3-2); 2.ESS1.C (4-ESS1-1),(4-ESS2-1); 2.ESS2.A (4-ESS2-1); 2.ESS2.B (4-ESS2-2); 2.ESS2.C (4-ESS2-2); 2.ETS1.B (4-ESS3-2); 2.ETS1.C (4-ESS3-2); 3.LS4.A (4-ESS1-1); 5.ESS2.A (4-ESS2-1); 5.ESS2.C (4-ESS2-2); MS.LS4.A (4-ESS1-1); MS.ESS1.C (4-ESS1-1),(4-ESS2-2); MS.ESS2.A (4-ESS1-1),(4-ESS2-2),(4-ESS3-2); MS.ESS2.B (4-ESS1-1),(4-ESS2-2); MS.ESS3.B (4-ESS3-2); MS.ETS1.B (4-ESS3-2)*

*New York State Next Generation Learning Standards Connections:*

*ELA/Literacy–*

- 4R1** Locate and refer to relevant details and evidence when explaining what a text says explicitly/implicitly and make logical inferences. (4-ESS3-2)
- 4R7** Identify information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, illustrations, and explain how the information contributes to an understanding of the text). (4-ESS2-2)
- 4W6** Conduct research to answer questions, including self-generated questions, and to build knowledge through investigating multiple aspects of a topic. (4-ESS1-1),(4-ESS2-1)
- 4W7** Recall relevant information from experiences or gather relevant information from multiple sources; take notes and categorize information, and provide a list of sources. (4-ESS1-1),(4-ESS2-1)
- 4W5** Draw evidence from literary or informational texts to respond and support analysis, reflection, and research by applying grade 4 reading standards. (4-ESS1-1)

*Mathematics–*

- MP.2** Reason abstractly and quantitatively. (4-ESS1-1),(4-ESS2-1),(4-ESS3-2)
- MP.4** Model with mathematics. (4-ESS1-1),(4-ESS2-1),(4-ESS3-2)
- MP.5** Use appropriate tools strategically. (4-ESS2-1)
- NY-4.MD.1** Know relative sizes of measurement units: ft., in.; km, m, cm. Know the conversion factor and use it to convert measurements in a larger unit in terms of a smaller unit: ft., in.; Km, m, cm; hr., min., sec. Given the conversion factor, convert all other measurements within a single system of measurement from a larger unit to a smaller unit. Record measurement equivalents in a two-column table. (4-ESS1-1),(4-ESS2-1)
- NY-4.MD.2** Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money. Solve problems involving fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams that feature a measurement scale, such as number line diagrams. (4-ESS2-1),(4-ESS2-2)
- NY-4.OA.1** Interpret a multiplication equation as a comparison. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-2)

\*Connection boxes updated as of September 2018

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