

**DCI: Waves and Their Applications in Technologies for Information Transfer**

**4.PS4.A: Wave Properties**

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. (4-PS4-1)

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**4.PS4.A: Wave Properties**

Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)

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**4.PS4.B: Electromagnetic Radiation**

An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)

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**4.PS4.C: Information Technologies and Instrumentation**

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)

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**4.ETS1.C: Optimizing the Design Solution**

Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

(4-PS4-3)

**DCI: Energy**

**4.PS3.A: Definitions of Energy**

The faster a given object is moving, the more energy it possesses.

(4-PS3-1)

**DCI: Energy**

### **4.PS3.A: Definitions of Energy**

Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2)

**DCI: Energy**

### **4.PS3.B: Conservation of Energy and Energy Transfer**

Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2)

**DCI: Energy**

### **4.PS3.B: Conservation of Energy and Energy Transfer**

Light also transfers energy from place to place. (4-PS3-2)

**DCI: Energy**

### **4.PS3.B: Conservation of Energy and Energy Transfer**

Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2)

**DCI: Energy**

### **4.PS3.A: Definitions of Energy**

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**DCI: Energy**

### **4.PS3.B: Conservation of Energy and Energy Transfer**

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**DCI: Energy**

### **4.PS3.C: Relationship Between Energy and Forces**

When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)

**DCI: Energy**

### **4.PS3.B: Conservation of Energy and Energy Transfer**

Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-4)

**DCI: Energy**

### **4.PS3.D: Energy in Chemical Processes and Everyday Life**

The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)

**DCI: Energy**

### **4.ETS1.A: Defining and Delimiting Engineering Problems**

Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (4-PS3-4)

#### **Performance Expectation**

##### **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.

#### **Performance Expectation**

##### **4-PS4-2: Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.**

**Clarification Statement:** none

**Assessment Boundary:** Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.

**Performance Expectation**

**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.

**Assessment Boundary:** none

**Performance Expectation**

**4-PS3-1: Use evidence to construct an explanation relating the speed of an object to the energy of that object.**

**Clarification Statement:** none

**Assessment Boundary:** Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.

**Performance Expectation**

**4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.**

**Clarification Statement:** none

**Assessment Boundary:** Assessment does not include quantitative measurements of energy.

### Performance Expectation

#### **4-PS3-3: Ask questions and predict outcomes about the changes in energy that occur when objects collide.**

**Clarification Statement:** Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.

**Assessment Boundary:** Assessment does not include quantitative measurements of energy.

### Performance Expectation

#### **4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.**

**Clarification Statement:** Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.

**Assessment Boundary:** Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.

### Science and Engineering Practice

#### **Developing and Using Models**

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.

Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)

## Science and Engineering Practice

### Developing and Using Models

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.

**Develop a model to describe phenomena.** (4-PS4-2)

## Science and Engineering Practice

### Constructing Explanations and Designing Solutions

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.

**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)

## Science and Engineering Practice

### Constructing Explanations and Designing Solutions

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.

**Use evidence (e.g., measurements, observations, patterns) to construct an explanation.** (4-PS3-1)

## Science and Engineering Practice

### Planning and Carrying Out Investigations

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.

Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

(4-PS3-2)

## Science and Engineering Practice

### Asking Questions and Defining Problems

Asking questions and defining problems in grades 3–5 builds from grades K–2 experiences and progresses to specifying qualitative relationships.

Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3)

## Science and Engineering Practice

### Constructing Explanations and Designing Solutions

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.

Apply scientific ideas to solve design problems. (4-PS3-4)

### Crosscutting Concept

#### Patterns

Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)

### Crosscutting Concept

#### Patterns

Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)

### Crosscutting Concept

#### Cause and Effect

Cause and effect relationships are routinely identified. (4-PS4-2)

### Crosscutting Concept

#### **Energy and Matter**

Energy can be transferred in various ways and between objects. (4-  
PS3-1)

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### Connection to Nature of Science

#### **Science Knowledge Is Based on Empirical Evidence**

Science findings are based on recognizing patterns. (4-PS4-1)

### Connection to Engineering, Technology, and Applications of Science

#### **Interdependence of Science, Engineering, and Technology**

Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)

**Connection to Engineering, Technology, and Applications of Science**

**Science Is a Human Endeavor**

Science affects everyday life. (4-PS3-4)

**Connection to Engineering, Technology, and Applications of Science**

**Science Is a Human Endeavor**

Most scientists and engineers work in teams. (4-PS3-4)

**Connection to Engineering, Technology, and Applications of Science**

**Influence of Science, Engineering, and Technology on Society and the Natural World**

Engineers improve existing technologies or develop new ones. (4-PS3-4)

**Common Core State Standards for ELA/Literacy**

**Reading Informational Text**

**RI.4.1 - Key Ideas and Details**

Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS4-3)

**Common Core State Standards for ELA/Literacy**

**Reading Informational Text**

**RI.4.9 - Integration of Knowledge and Ideas**

Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)

**Common Core State Standards for ELA/Literacy**

**Speaking & Listening**

**SL.4.5 - Presentation of Knowledge and Ideas**

Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-1), (4-PS4-2)

**Common Core State Standards for Mathematics**

**Geometry**

**4.G.A.1 - Draw and identify lines and angles, and classify shapes by properties of their lines and angles.**

Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.  
(4-PS4-1), (4-PS4-2)

**Common Core State Standards for Mathematics**

**Mathematical Practices**

**MP.4 - Model with mathematics**

CCSS text (4-PS4-1), (4-PS4-2)