Next Generation Science Standards Science

Grade 4

Adopted 2013

Energy 4-PS3

Students who demonstrate understanding can:

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

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

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

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

Waves and their Applications in Technologies for Information Transfer 4-PS4

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. 4-PS4-1

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

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information. 4-PS4-3

From Molecules to Organisms: Structures and Processes 4-LS1

Students who demonstrate understanding can:

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. 4-LS1-1

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. 4-LS1-2

Earth's Place in the Universe 4-ESS1

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. 4-ESS1-1

Earth's Systems 4-ESS2

Students who demonstrate understanding can:

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. 4-ESS2-1

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. 4-ESS2-2

Earth and Human Activity 4-ESS3

Students who demonstrate understanding can:

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. 4-ESS3-1

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. 4-ESS3-2

Engineering Design 3-5-ETS1

Students who demonstrate understanding can:

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1-1

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-2

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. 3-5-ETS1-3

Science and Engineering Practices SEP

1. **Analyzing and Interpreting Data** SEP.1

   3-5. 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. SEP.1.3-5

   - Analyze and interpret data to make sense of phenomena using logical reasoning. SEP.1.3-5.1

2. **Asking Questions and Defining Problems** SEP.2

   3-5. Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. SEP.2.3-5

   - Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. SEP.2.3-5.3
   - Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. SEP.2.3-5.4

3. Constructing Explanations and Designing Solutions SEP.3

3-5. 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. SEP.3.3-5

- Use evidence (e.g., measurements, observations, patterns) to construct an explanation. SEP.3.3-5.3
- Apply scientific ideas to solve design problems. SEP.3.3-5.4
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. SEP.3.3-5.5
- Identify the evidence that supports particular points in an explanation. SEP.3.3-5.6
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. SEP.3.3-5.7

4. Developing and Using Models SEP.4

3-5. 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. SEP.4.3-5

- Develop models to describe phenomena. SEP.4.3-5.1
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle. SEP.4.3-5.2
- Use a model to test interactions concerning the functioning of a natural system. SEP.4.3-5.3
- Develop a model to describe phenomena. SEP.4.3-5.4

5. Engaging in Argument from Evidence SEP.5

3-5. 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). SEP.5.3-5

- Construct an argument with evidence, data, and/or a model. SEP.5.3-5.1

6. Obtaining, Evaluating, and Communicating Information SEP.6

3-5. Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. SEP.6.3-5

- Obtain and combine information from books and other reliable media to explain phenomena. SEP.6.3-5.1

7. Planning and Carrying Out Investigations SEP.7

3-5. 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. SEP.7.3-5

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. SEP.7.3-5.1
- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. SEP.7.3-5.3
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. SEP.7.3-5.4

9. Scientific Knowledge is Based on Empirical Evidence SEP.9

- Science findings are based on recognizing patterns. SEP.9.2

Disciplinary Core Ideas DCI

A. Definitions of Energy DCI.PS3.A

- The faster a given object is moving, the more energy it possesses. DCI.PS3.A.3-5.1
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. DCI.PS3.A.3-5.2

B. Conservation of Energy and Energy Transfer DCI.PS3.B

- 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. DCI.PS3.B.3-5.1
- Light also transfers energy from place to place. DCI.PS3.B.3-5.2
- 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. DCI.PS3.B.3-5.3

C. Relationship Between Energy and Forces DCI.PS3.C

- When objects collide, the contact forces transfer energy so as to change the objects' motions. DCI.PS3.C.3-5.1

D. Energy in Chemical Processes and Everyday Life DCI.PS3.D

- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. DCI.PS3.D.3-5.1

A. Wave Properties DCI.PS4.A

- 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. (Note: This grade band endpoint was moved from K–2.) DCI.PS4.A.3-5.2
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). DCI.PS4.A.3-5.3

B. Electromagnetic Radiation DCI.PS4.B

- An object can be seen when light reflected from its surface enters the eyes. DCI.PS4.B.3-5.3

C. Information Technologies and Instrumentation DCI.PS4.C

- 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. DCI.PS4.C.3-5.2

A. Structure and Function DCI.LS1.A

- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. DCI.LS1.A.3-5.2

D. Information Processing DCI.LS1.D

- 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. DCI.LS1.D.3-5.2

C. The History of Planet Earth DCI.ESS1.C

- 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. DCI.ESS1.C.3-5.2

A. Earth Materials and Systems DCI.ESS2.A

- 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. DCI.ESS2.A.3-5.2

B. Plate Tectonics and Large-Scale System Interactions DCI.ESS2.B

- 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. DCI.ESS2.B.3-5.2

E. Biogeology DCI.ESS2.E

- Living things affect the physical characteristics of their regions. DCI.ESS2.E.3-5.2

A. Natural Resources DCI.ESS3.A

- Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. DCI.ESS3.A.3-5.2

B. Natural Hazards DCI.ESS3.B

- 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. DCI.ESS3.B.3-5.3

A. Defining Engineering Problems DCI.ETS1.A

- 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. DCI.ETS1.A.3-5.2

A. Defining and Delimiting Engineering Problems DCI.ETS1.A

- 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. DCI.ETS1.A.3-5.1

B. Developing Possible Solutions DCI.ETS1.B

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. DCI.ETS1.B.3-5.2
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. DCI.ETS1.B.3-5.3
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. DCI.ETS1.B.3-5.4

B. Designing Solutions to Engineering Problems DCI.ETS1.B

- Testing a solution involves investigating how well it performs under a range of likely conditions. DCI.ETS1.B.3-5.1

C. Optimizing the Design Solution DCI.ETS1.C

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. DCI.ETS1.C.3-5.2

Crosscutting Concepts CCC

1. Patterns CCC.1

- Similarities and differences in patterns can be used to sort and classify natural phenomena. CCC.1.3-5.6
- Similarities and differences in patterns can be used to sort and classify designed products. CCC.1.3-5.7
- Patterns can be used as evidence to support an explanation. CCC.1.3-5.8

2. Cause and Effect CCC.2

- Cause and effect relationships are routinely identified. CCC.2.3-5.3
- Cause and effect relationships are routinely identified, tested, and used to explain change. CCC.2.3-5.4
- Cause and effect relationships are routinely identified and used to explain change. CCC.2.3-5.5

4. Systems and System Models CCC.4

- A system can be described in terms of its components and their interactions. CCC.4.3-5.2

5. Energy and Matter CCC.5

- Energy can be transferred in various ways and between objects. CCC.5.3-5.2

8. Influence of Engineering, Technology, and Science on Society and the Natural World CCC.8

- People's needs and wants change over time, as do their demands for new and improved technologies. CCC.8.3-5.5
- Engineers improve existing technologies or develop new ones. CCC.8.3-5.6
- Over time, people's needs and wants change, as do their demands for new and improved technologies. CCC.8.3-5.7
- Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. CCC.8.3-5.8

9. Interdependence of Science, Engineering, and Technology CCC.9

- Knowledge of relevant scientific concepts and research findings is important in engineering. CCC.9.3-5.3

11. Scientific Knowledge Assumes an Order and Consistency in Natural Systems CCC.11

- Science assumes consistent patterns in natural systems. CCC.11.3-5.3

12. Science is a Human Endeavor CCC.12

- Science affects everyday life. CCC.12.3-5.1
- Most scientists and engineers work in teams. CCC.12.3-5.2