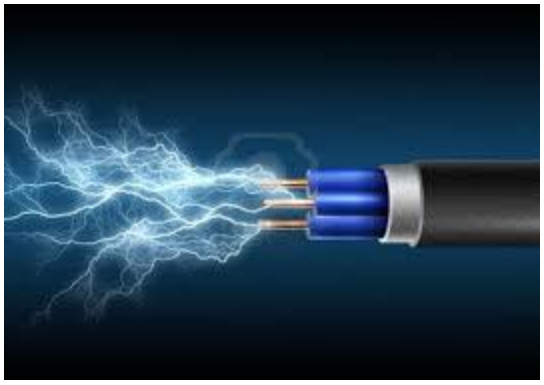
UNIT 3 ENERGY



Fourth Grade | Rogers Public Schools

Unit 3: Energy 9 weeks

In this unit, students will explore energy and its various forms. They will understand how energy can be transferred, stored, and conserved. Students will understand that energy can be transferred from place to place by sound, light, heat, and electric currents. Students use their evidence from investigations to explain how energy can be transferred. Students will also investigate how energy changes when objects collide. They will use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object.

Students will apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. Devices should use stored energy to cause motion, produce light or produce sound and/or convert motion energy to electric energy. (Examples could include: electric circuits that convert electrical energy into motion, light or sound energy; a solar heater/oven that converts light to heat.)

Students will also obtain and combine information to describe how energy and fuels are derived from natural resources. Students should be able to distinguish renewable energy resources and nonrenewable energy resources. Students should be able to describe how our usage of these resources (renewable and nonrenewable) affects our environment and ultimately affect us as humans.

Unit 3 Performance Expectations

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

- **4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.**
  Assessment Boundary: Assessment does not include quantitative measurements of energy.

- **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.

- **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, light, or sound energy; or, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, and 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.

- **4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.**
  Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, or sunlight; non-renewable energy resources are fossil fuels or fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from the burning of fossil fuels.

Unit 3 Essential Questions:

- What is energy?
- How is energy transferred?
- How can energy be used to solve a problem?

In Unit 3, students will understand…

- The faster a given object is moving, the more energy it possesses.
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.
- 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 collisions, some energy is typically also transferred to the surrounding air, and as a result, the air gets heated and sound is produced.
- Light also transfers energy from place to place.
- Energy can also be transferred from place to place by electric currents, which can be used locally to produce motion, sound, heat, or light.
- Currents may have been produced to begin with by transforming the energy of motion into electrical energy.
- The expression "produce energy" typically refers to the conversion of stored energy into a desired form of practical use.
- 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.

Foundational Knowledge:

Prior to 4th grade, students should have knowledge, understanding of, and experiences with the following ideas:

- When objects touch or collide, they push on one another and can change motion.
- Light travels from place to place and can be redirected.
- Living things need water, air and resources from the land. They live in places that have things they need.
- Humans use natural resources for everything they do.

With the implementation of new standards, students may not have had opportunities to engage in these foundational understandings and ideas before 4th grade. You may need to provide opportunities for students to experience these ideas as you move forward.

Unit Vocabulary:

energy	insulator	turbine
electricity	transfer/transferred	natural resource
electric current	conserve/conservation	renewable
circuit	collide/collision	nonrenewable
conductor	convert	fossil fuels

Additional Content Connections:

*These connections provide opportunities to score to other content standards with focused instruction.

ELA:

- Speaking and Listening
  - SL.4.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.
  - SL.4.2 Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
- Writing
  - W.4.1 Write opinion pieces on topics or texts supporting the opinion with reasons.
  - W.4.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
  - W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources: take notes and categorize information; provide a list of sources.
  - W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

Social Studies:

- Geography: Human-Environment Interaction
  - G.9.4.1 Analyze effects over time of human-generated changes in the physical environment (e.g., deforestation, dams, pollution)
- Geography: Spatial Patterns and Movement
  - G.10.4.1 Compare *natural resources* in various geographic regions to influence human settlement patterns

Energy

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. [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.]

4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

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.]

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, light, or sound energy; or, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, and 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.]

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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

Asking Questions and Defining Problems

Asking questions and defining problems in grades 3–5 builds on 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)

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)

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

Obtaining, Evaluating, and Communicating Information

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

- Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)

Disciplinary Core Ideas

PS3.A: Definitions of Energy

- The faster a given object is moving, the more energy it possesses. (4-PS3-1)
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2, 4-PS3-3)

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, 4-PS3-3)
- Light also transfers energy from place to place. (4-PS3-2)
- 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. (4-PS3-2, 4-PS3-4)

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)

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)

ESS3.A: Natural Resources

- 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. (4-ESS3-1)

ETS1.A: Defining 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)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)

Energy and Matter

- Energy can be transferred in various ways and between objects. (4-PS3-1, 4-PS3-2, 4-PS3-3, 4-PS3-4)

Connections 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-ESS3-1)

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

- Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1)
- Engineers improve existing technologies or develop new ones. (4-PS3-4)

Connections to Nature of Science

Science is a Human Endeavor

- Most scientists and engineers work in teams. (4-PS3-4)
- Science affects everyday life. (4-PS3-4)