

## 4-PS3-4 Energy

Students who demonstrate understanding can:

- 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.]

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

### Science and Engineering Practices

#### 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.

### Disciplinary Core Ideas

#### 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.

#### 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.

#### 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. (*secondary*)

### Crosscutting Concepts

#### Energy and Matter

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

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

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

- Engineers improve existing technologies or develop new ones.

#### Connections to Nature of Science

#### Science is a Human Endeavor

- Most scientists and engineers work in teams.
- Science affects everyday life.

### Observable features of the student performance by the end of the grade:

1	Using scientific knowledge to generate design solutions	
	a	Given a problem to solve, students collaboratively design a solution that converts energy from one form to another. In the design, students:
		<ol style="list-style-type: none"> <li>Specify the initial and final forms of energy (e.g., electrical energy, motion, light).</li> <li>Identify the device by which the energy will be transformed (e.g., a light bulb to convert electrical energy into light energy, a motor to convert electrical energy into energy of motion).</li> </ol>
2	Describing criteria and constraints, including quantification when appropriate	
	a	Students describe the given criteria and constraints of the design, which include:
		<ol style="list-style-type: none"> <li>Criteria: <ol style="list-style-type: none"> <li>The initial and final forms of energy.</li> <li>Description of how the solution functions to transfer energy from one form to another.</li> </ol> </li> </ol>

		ii. Constraints:
		1. The materials available for the construction of the device.
		2. Safety considerations.
3	Evaluating potential solutions	
	a	Students evaluate the proposed solution according to how well it meets the specified criteria and constraints of the problem.
4	Modifying the design solution	
	a	Students test the device and use the results of the test to address problems in the design or improve its functioning.