

## 4-PS3-2 Energy

Students who demonstrate understanding can:

- 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.]**

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

#### 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.

### Disciplinary Core Ideas

#### PS3.A: Definitions of Energy

- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

#### 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.
- Light also transfers energy from place to place.
- 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.

### Crosscutting Concepts

#### Energy and Matter

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

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

1	Identifying the phenomenon under investigation
a	From the given investigation plan, students describe* the phenomenon under investigation, which includes the following ideas:
	i. The transfer of energy, including:
	1. Collisions between objects.
	2. Light traveling from one place to another.
	3. Electric currents producing motion, sound, heat, or light.
	4. Sound traveling from one place to another.
	5. Heat passing from one object to another.
	6. Motion, sound, heat, and light causing a different type of energy to be observed after an interaction (e.g., in a collision between two objects, one object may slow down or stop, the other object may speed up, and the objects and surrounding air may be heated; a specific sound may cause the movement of an object; the energy associated with the motion of an object, via an electrical current, may be used to turn on a light).
b	Students describe* the purpose of the investigation, which includes providing evidence for an explanation of the phenomenon, including the idea that energy can be transferred from place to place by:
	i. Moving objects.

		ii. Sound.
		iii. Light.
		iv. Heat.
		v. Electric currents.
2	<b>Identifying the evidence to address the purpose of the investigation</b>	
	a	From the given investigation plan, students describe* the data to be collected that will serve as the basis for evidence, including:
		i. The motion and collision of objects before and after an interaction (e.g., when a given object is moving fast, it can move another object farther than when the same object is moving more slowly).
		ii. The relative presence of sound, light, or heat (including in the surrounding air) before and after an interaction (e.g. shining a light on an object can increase the temperature of the object; a sound can move an object).
		iii. The presence of electric currents flowing through wires causally linking one form of energy output (e.g., a moving object) to another form of energy output (e.g., another moving object; turning on a light bulb).
	b	Students describe* how their observations will address the purpose of the investigation, including how the observations will provide evidence that energy, in the form of light, sound, heat, and motion, can be transferred from place to place by sound, light, heat, or electric currents (e.g., in a system in which the motion of an object generates an observable electrical current to turn on a light, energy (from the motion of an object) must be transferred to another place (energy in the form of the light bulb) via the electrical current, because the motion doesn't cause the light bulb to light up if the wire is not completing a circuit between them; when a light is directed at an object, energy (in the form of light) must be transferred from the source of the light to its destination and can be observed in the form of heat, because if the light is blocked, the object isn't warmed.
3	<b>Planning the investigation</b>	
	a	From the given investigation plan, students identify and describe* how the data will be observed and recorded, including the tools and methods for collecting data on:
		i. The motion and collision of objects, including any sound or heat producing the motion/collision, or produced by the motion/collision.
		ii. The presence of energy in the form of sound, light, or heat in one place as a result of sound, light, or heat in a different place.
		iii. The presence of electric currents in wires and the presence of energy (in the form of sound, light, heat, or motion resulting from the flow of electric currents through a device).
	b	Students describe* the number of trials, controlled variables, and experimental set up.
4	<b>Collecting the data</b>	
	a	Students make and record observations according to the given investigation plan to provide evidence that:
		i. Energy is present whenever there are moving objects, sound, light, or heat.
		ii. That energy has been transferred from place to place (e.g., a bulb in a circuit is not lit until a switch is closed and it lights, indicating that energy is transferred through electric current in a wire to light the bulb; a stationary ball is struck by a moving ball, causing the stationary ball to move and the moving ball to slow down, indicating that energy has been transferred from the moving ball to the stationary one).