Energy Conservation:

Kinetic Energy, Potential Energy, and Heat

It is true that we become acquainted with the physical universe solely by means of our senses, but . . . the final test of physical reality . . . is the fact that the physical world remains unchanged in quantity, or fixed in amount, however it may be measured. Tried by this test, there are only two classes of things in the physical world—matter and energy.

—Henry Smith Carhart (1844–1920) and Horatio Nelson Chute (1847–1928)

Lab 10

✔ Exercise Goals

After completing this exercise, students should be able to:

1. Collect force data as a piece of rubber tubing is stretched.
2. Graph the force data of a stretched rubber tube on a force versus distance graph.
3. Determine the energy stored in the stretched rubber tubing by finding the area under the force versus distance graph.
4. Investigate and measure the frictional force of a wooden block sliding on the floor.
5. Predict and record the distance the block will slide on the floor.

NGSS Connections

K. Forces and Interactions: Pushes and Pulls

- **K-PS2-1.** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
- **K-PS2-2.** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

4. Energy

- **4-PS3-1.** Use evidence to construct an explanation relating the speed of an object to the energy of that object.
- **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-PS3-3.** Ask questions and predict outcomes about the changes in energy that occur when objects collide.
- **4-PS3-4.** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. Points are considered to identify aspects of a model or prototype that can be improved.

Energy is defined as the ability to do work. In addition, energy is conserved; that is, it cannot be created or destroyed. It can only be transferred or converted to other forms. In this lab, we will watch potential energy being converted to kinetic energy and thermal energy (heat). Exercising is a good analogy. While exercising, your body converts chemical potential energy (fats, carbohydrates, and proteins) into motion, or kinetic energy. The heat you feel after exercising is an example of thermal energy, which is also a part of the chemical energy conversion.

In today's lab, you will be launching a block of wood out of a slingshot and observing it travel across the room. It will not make it to the other side of the room because of its frictional interaction with the floor. This frictional interaction creates heat, which is dissipated into the environment. You will measure the **potential energy** stored in the rubber band before the block is launched. You will also observe the conversion to **kinetic energy** as the block begins to slide across the floor, and will measure the force of friction acting on the block and limiting its travel. You will also predict the block's sliding distance based on these known quantities.

In order to calculate the predictions and results for these actions, you will use the formulas for potential energy and kinetic energy. The formula for potential energy is:

$$\text{Potential energy} = \text{Force} \times \text{Distance} \qquad PE = F \cdot d \qquad \text{[Eq. 1]}$$

The formula for kinetic energy is:

$$\text{Kinetic energy} = \tfrac{1}{2}\,\text{Mass} \times \text{Velocity}^2 \qquad KE = \tfrac{1}{2}\, m \cdot v^2 \qquad \text{[Eq. 2]}$$