**Table 1** **Energy of a Falling 75 g Egg**

| Time (s) | Height (m) | Speed (m/s) | $PE_g$ (J) | $KE$ (J) | $ME$ (J) |
|---|---|---|---|---|---|
| 0.00 | 1.0 | 0.00 | 0.74 | 0.00 | 0.74 |
| 0.10 | 0.95 | 0.98 | 0.70 | 0.036 | 0.74 |
| 0.20 | 0.80 | 2.0 | 0.59 | 0.15 | 0.74 |
| 0.30 | 0.56 | 2.9 | 0.41 | 0.33 | 0.74 |
| 0.40 | 0.22 | 3.9 | 0.16 | 0.58 | 0.74 |

In the absence of friction, the total mechanical energy remains the same. This principle is called *conservation of mechanical energy.* Although the amount of mechanical energy is constant, mechanical energy itself can change form. For instance, consider the forms of energy for the falling egg, as shown in **Table 1.** As the egg falls, the potential energy is continuously converted into kinetic energy. If the egg were thrown up in the air, kinetic energy would be converted into gravitational potential energy. In either case, mechanical energy is conserved. The conservation of mechanical energy can be written symbolically as follows:

**CONSERVATION OF MECHANICAL ENERGY**

$$ME_i = ME_f$$

**initial mechanical energy = final mechanical energy**
**(in the absence of friction)**

The mathematical expression for the conservation of mechanical energy depends on the forms of potential energy in a given problem. For instance, if the only force acting on an object is the force of gravity, as in the egg example, the conservation law can be written as follows:

$$\tfrac{1}{2}mv_i^2 + mgh_i = \tfrac{1}{2}mv_f^2 + mgh_f$$

If other forces (except friction) are present, simply add the appropriate potential energy terms associated with each force. For instance, if the egg happened to compress or stretch a spring as it fell, the conservation law would also include an elastic potential energy term on each side of the equation.

In situations in which frictional forces are present, the principle of mechanical energy conservation no longer holds because kinetic energy is not simply converted to a form of potential energy. This special situation will be discussed more thoroughly later in this section.

## Quick Lab

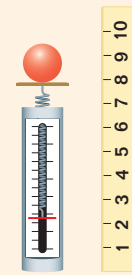
### Mechanical Energy

**MATERIALS LIST**

- **medium-sized spring (spring balance)**
- **assortment of small balls, each having a different mass**
- **ruler**
- **tape**
- **scale or balance**

**SAFETY**

Students should wear goggles to perform this lab.




First, determine the mass of each of the balls. Then, tape the ruler to the side of a tabletop so that the ruler is vertical. Place the spring vertically on the tabletop near the ruler, and compress the spring by pressing down on one of the balls. Release the ball, and measure the maximum height it achieves in the air. Repeat this process five times, and be sure to compress the spring by the same amount each time. Average the results. From the data, can you predict how high each of the other balls will rise? Test your predictions. (Hint: Assume mechanical energy is conserved.)