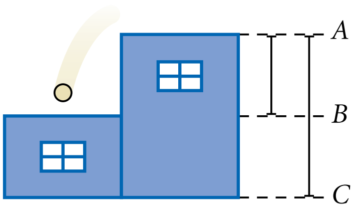

Figure 7
If *B* is the zero level, then all the gravitational potential energy is converted to kinetic energy as the ball falls from *A* to *B*. If *C* is the zero level, then only part of the total gravitational potential energy is converted to kinetic energy during the fall from *A* to *B*.

Suppose you drop a volleyball from a second-floor roof and it lands on the first-floor roof of an adjacent building (see **Figure 7**). If the height is measured from the ground, the gravitational potential energy is not zero because the ball is still above the ground. But if the height is measured from the first-floor roof, the potential energy is zero when the ball lands on the roof.

Gravitational potential energy is a result of an object's position, so it must be measured relative to some *zero level*. The zero level is the vertical coordinate at which gravitational potential energy is defined to be zero. This zero level is arbitrary, and it is chosen to make a specific problem easier to solve. In many cases, the statement of the problem suggests what to use as a zero level.

Elastic potential energy depends on distance compressed or stretched

Imagine you are playing with a spring on a tabletop. You push a block into the spring, compressing the spring, and then release the block. The block slides across the tabletop. The kinetic energy of the block came from the stored energy in the compressed spring. This potential energy is called **elastic potential energy.** Elastic potential energy is stored in any compressed or stretched object, such as a spring or the stretched strings of a tennis racket or guitar.

elastic potential energy

the energy available for use when a deformed elastic object returns to its original configuration

The length of a spring when no external forces are acting on it is called the *relaxed length* of the spring. When an external force compresses or stretches the spring, elastic potential energy is stored in the spring. The amount of energy depends on the distance the spring is compressed or stretched from its relaxed length, as shown in **Figure 8.** Elastic potential energy can be determined using the following equation:

ELASTIC POTENTIAL ENERGY

$$PE_{elastic} = \frac{1}{2}kx^2$$

$$\textbf{elastic potential energy} = \frac{1}{2} \times \textbf{spring constant} \times \left(\begin{array}{c}\textbf{distance compressed}\\ \textbf{or stretched}\end{array}\right)^2$$

The symbol k is called the **spring constant,** or force constant. For a flexible spring, the spring constant is small, whereas for a stiff spring, the spring constant is large. Spring constants have units of newtons divided by meters (N/m).

spring constant

a parameter that is a measure of a spring's resistance to being compressed or stretched

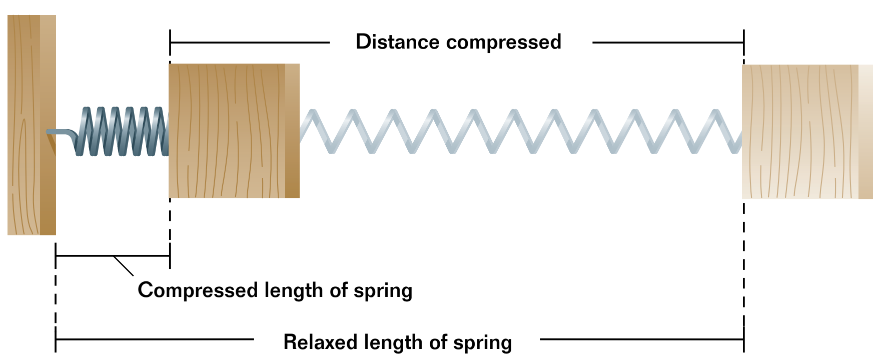

Figure 8
The distance to use in the equation for elastic potential energy is the distance the spring is compressed or stretched from its relaxed length.