

## POTENTIAL ENERGY

Consider the balanced boulder shown in **Figure 6**. As long as the boulder remains balanced, it has no kinetic energy. If it becomes unbalanced, it will fall vertically to the desert floor and will gain kinetic energy as it falls. What is the origin of this kinetic energy?

### Potential energy is stored energy

**Potential energy** is associated with an object that has the potential to move because of its position relative to some other location. Unlike kinetic energy, potential energy depends not only on the properties of an object but also on the object's interaction with its environment.

### Gravitational potential energy depends on height from a zero level

You learned earlier how gravitational forces influence the motion of a projectile. If an object is thrown up in the air, the force of gravity will eventually cause the object to fall back down. Similarly, the force of gravity will cause the unbalanced boulder in the previous example to fall. The energy associated with an object due to the object's position relative to a gravitational source is called **gravitational potential energy**.

Imagine an egg falling off a table. As it falls, it gains kinetic energy. But where does the egg's kinetic energy come from? It comes from the gravitational potential energy that is associated with the egg's initial position on the table relative to the floor. Gravitational potential energy can be determined using the following equation:

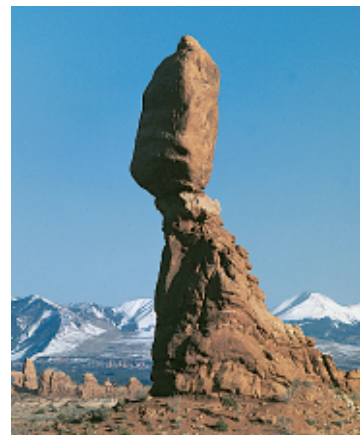
#### GRAVITATIONAL POTENTIAL ENERGY

$$PE_g = mgh$$

**gravitational potential energy = mass  $\times$  free-fall acceleration  $\times$  height**

The SI unit for gravitational potential energy, like for kinetic energy, is the joule. Note that the definition for gravitational potential energy in this chapter is valid only when the free-fall acceleration is constant over the entire height, such as at any point near the Earth's surface. Furthermore, gravitational potential energy depends on both the height and the free-fall acceleration, neither of which is a property of an object.

Also note that the height,  $h$ , is measured from an arbitrary zero level. In the example of the egg, if the floor is the zero level, then  $h$  is the height of the table, and  $mgh$  is the gravitational potential energy relative to the floor. Alternatively, if the table is the zero level, then  $h$  is zero. Thus, the potential energy associated with the egg relative to the table is zero.



**Figure 6**

Energy is present in this example, but it is not kinetic energy because there is no motion. What kind of energy is it?

### potential energy

*the energy associated with an object because of the position, shape, or condition of the object*

### gravitational potential energy

*the potential energy stored in the gravitational fields of interacting bodies*

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