Current can be direct or alternating

There are two different types of current: *direct current* (dc) and *alternating current* (ac). In direct current, charges move in only one direction with negative charges moving from a lower to higher electric potential. Hence, the conventional current is directed from the positive terminal to the negative terminal of a battery. Note, however, that the electrons actually move in the opposite direction.

Consider a light bulb connected to a battery. The potential difference between the terminals of a battery is fixed, so batteries always generate a direct current.

In alternating current, the terminals of the source of potential difference are constantly changing sign. Hence, there is no net motion of the charge carriers in alternating current; they simply vibrate back and forth. If this vibration were slow enough, you would notice flickering in lights and similar effects in other appliances. To eliminate this problem, alternating current is made to change direction rapidly. In the United States, alternating current oscillates 60 times every second. Thus, its frequency is 60 Hz. The graphs in **Figure 14** compare direct and alternating current. Alternating current has advantages that make it more practical for use in transferring electrical energy. For this reason, the current supplied to your home by power companies is alternating current rather than direct current.

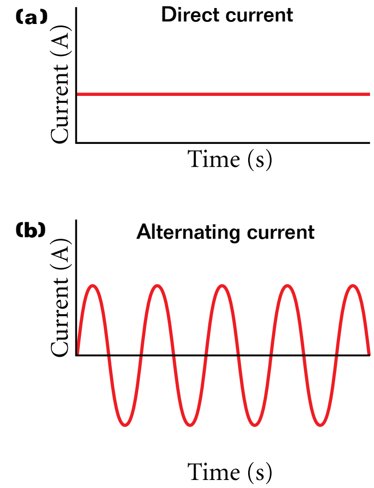

Figure 14
(a) The direction of direct current does not change, while **(b)** the direction of alternating current continually changes.

ENERGY TRANSFER

When a battery is used to maintain an electric current in a conductor, chemical energy stored in the battery is continuously converted to the electrical energy of the charge carriers. As the charge carriers move through the conductor, this electrical energy is converted to internal energy due to collisions between the charge carriers and other particles in the conductor.

For example, consider a light bulb connected to a battery, as shown in **Figure 15(a).** Imagine a charge Q moving from the battery's terminal to the light bulb and then back to the other terminal. The changes in electrical potential energy are shown in **Figure 15(b).** If we disregard the resistance of the connecting wire, no loss in energy occurs as the charge moves through the wire (A to B). But when the charge moves through the filament of the light bulb (B to C), which has a higher resistance than the wire has, it loses electrical potential energy due to collisions. This electrical energy is converted into internal energy, and the filament warms up and glows.

When the charge first returns to the battery's terminal (D), its potential energy is, by convention, zero, and the battery must do work on the charge. As the charge moves between the terminals of the battery (D to A), its electrical potential energy increases by $Q\Delta V$ (where ΔV is the potential difference across the two terminals). The battery's chemical energy must decrease by the same amount.

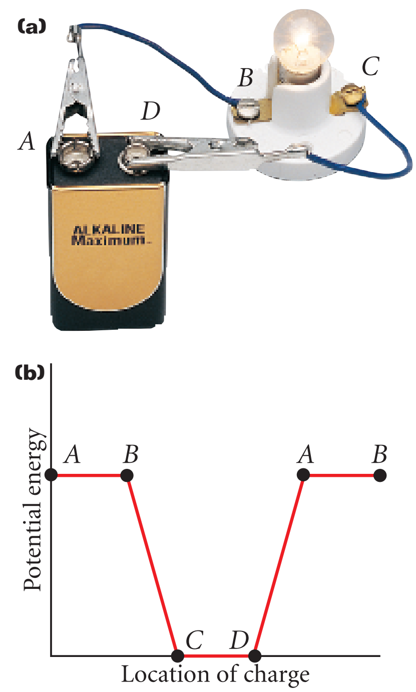

Figure 15
A charge leaves the battery at A with a certain amount of electrical potential energy. The charge loses this energy while moving from B to C, and then regains the energy as it moves through the battery from D to A.