Introducing Current Electricity

12.1

Electricity is an important aspect of our daily lives (Figure 1). Most appliances use electricity that flows through conducting wires in the walls of our homes. What kind of electricity is this, and how do we produce it?

Figure 1 With the flick of a switch, a room is filled with light, water in a kettle begins to boil, or a computer powers up. All this is possible because of electricity—the most widely used form of energy in the world.

current electricity the controlled flow of electrons through a conductor

The Flow of Electrons

In Chapter 11, you learned that electric charges can build up on the surface of an object until they are discharged. An example of electric discharge can be observed when lightning moves from cloud to cloud, or from a cloud to Earth. Unlike static electricity, **current electricity** refers to electric charges (electrons) that flow through a conductor in a controlled way.

Electrons are always moving. The difference between static and current electricity is that in static electricity the electrons gather in one place (the surface of an object) and move randomly in all directions (Figure 2(a)), whereas in current electricity there is a steady flow of electric charge (electrons) through a conductor (Figure 2(b)).

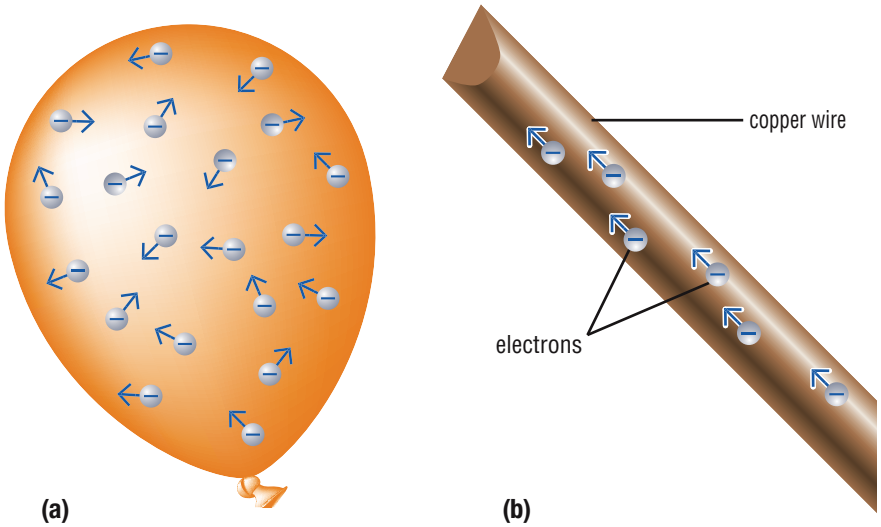

Figure 2 (a) Electrons on the surface of a rubber balloon move short distances in all directions. (b) Electrons flow through a copper wire in a controlled way.

LEARNING TIP

Word Origins

The word "static" means something that does not move.

Although electric charges flow between two objects during an electrostatic discharge, this flow follows an unpredictable path, and occurs only for a very short period of time. The steady flow of electrons in current electricity, however, means that charges are moving for much longer. This steady flow can be directed and used to power devices, which you will learn more about later in this chapter.

As you learned in Chapter 11, electrons move easily through conductors, such as copper and aluminum. Since human skin is a fair conductor, it is very dangerous to touch a conducting wire that has electricity moving through it. Too many electrons entering your body too quickly could be fatal. For safety, conducting wires are wrapped with an insulator, such as plastic, which prevents the flow of electrons from entering your body when you handle the cables (Figure 3).

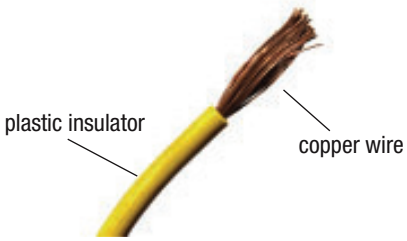

Figure 3 Copper wire, often used in electrical cables, is insulated with plastic.

Making Electrons Move

What makes electrons flow in a conductor? Consider an MP3 player and a television. A fully charged battery is needed to operate the MP3 player. If the battery is charged, electrons can flow through the MP3 player and it works. If the battery is dead, the electrons do not flow and the MP3 player does not work. Not all devices require a battery to create the flow of electrons. A television, for example, is usually plugged into a wall outlet. In this case, the flow of electrons is produced at an electric generating station. The electrons eventually flow into the wires in your home and then into your TV. If there is a blackout, electrons do not flow and the TV does not work. No matter what the electrical device is, to make it operate you need a source of electrical energy.

TRY THIS MODEL ELECTRON FLOW

SKILLS: Observing, Communicating

SKILLS HANDBOOK 3.B.6., 3.B.9.

In this activity, you will model the flow of electrons in a conductor using marbles to represent electrons.

Equipment and Materials: 2 rulers; 10 marbles; tape

1. Make a track for the marbles by taping the two rulers to a desk. The rulers must be parallel to each other and marble-width apart.
2. Place the 10 marbles at one end of the track, touching each other.
3. Push the first marble in the row. Keep pushing this marble until it has travelled the full length of the track. Record your observations. This trial represents a fully charged battery.
4. Repeat step 3 but this time push the first marble with less force. Record your observations. This trial represents a partly charged battery.

A. What determines the speed of the electrons? Use your observations to explain your answer. T/I C

B. Do you think the results would have been different if you used 1000 marbles instead of 10? Explain. T/I

C. Would it be possible to create a path that would allow the marbles to travel continuously? Explain. T/I

IN SUMMARY

- Static electricity involves the movement of electrons in an uncontrolled way.
- Current electricity involves the controlled flow of electrons through a conductor.
- Current electricity moves easily through a conductor and poorly through an insulator.
- Current electricity requires a source of electrical energy to create a flow of electrons.

CHECK YOUR LEARNING

1. What information in this section helped you understand the difference between static and current electricity? Discuss your answer with a classmate. K/U C
2. What are some of the useful properties of current electricity? Explain why. K/U
3. Explain why conductors and insulators are both required to construct the electrical wiring in your home. K/U
4. What is required for electricity to flow? Explain. K/U
5. What is the difference between static and current electricity? Give an example of each. K/U C
6. Why would it be challenging to use static electricity in electrical devices, such as your television or stereo? Explain. A