LESSON 3

Rechargeable Batteries

AP/WIDE WORLD PHOTOS

Batteries come in a variety of sizes and shapes. This "in the canal" hearing aid uses very small batteries.

INTRODUCTION

Has someone you know ever parked a car and left the headlights on for a long time? What happened the next time he or she tried to go somewhere? Did the car start? If not, what did your friend do to start it? In Lesson 2, you built a battery. What do you think would happen to that battery if you left the light connected to it turned on for a long time? In this lesson, you will explore answers to these questions.

OBJECTIVES FOR THIS LESSON

Test a battery.

Store energy in a battery.

Identify the energy changes that take place when a battery is connected to different devices.

Getting Started

1. With the class, review how you built your battery in Lesson 2 and what happened when you connected it to the lightbulb.

2. Think about your answers to the questions in the Introduction. Discuss your answers with the class.

Inquiry 3.1
Charging a Battery

PROCEDURE

1. Examine the dry-cell battery at your lab station. Will it light a bulb? Test it and see if it will (see Figure 3.1). Describe your test in your science notebook. What do you conclude about the energy in your battery?

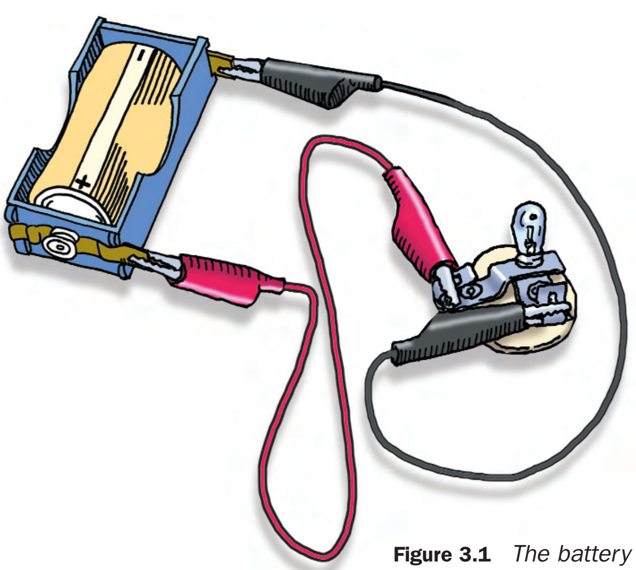

Figure 3.1 *The battery connected to a lightbulb*

MATERIALS FOR LESSON 3

For your group
- 1 battery charger

For you and your lab partner
- 1 D-cell battery
- 1 D-cell battery holder
- 1 miniature lightbulb
- 1 miniature lightbulb holder
- 1 student timer (or clock with a second hand)
- 1 electric motor with wire leads and alligator clips
- 1 black insulated connector wire with alligator clips
- 1 red insulated connector wire with alligator clips

2. You will use a battery charger for the rest of this inquiry. It is important to connect your battery correctly to the charger. Watch as your teacher demonstrates how to connect your battery to the charger safely.

3. Before you begin to work, review the Safety Tips with your class.

SAFETY TIPS

Be careful to avoid electrical shocks when you are connecting your battery to the charger. To avoid shocks, follow these procedures:

- Make sure the battery charger is unplugged when you insert and remove your battery.

- Make sure the batteries are placed correctly in the charger. The positive end of the battery should be at the positive end of the charging bay.

4. Put your battery in the battery charger, as shown in Figure 3.2, and plug in the charger for 3.0 minutes.

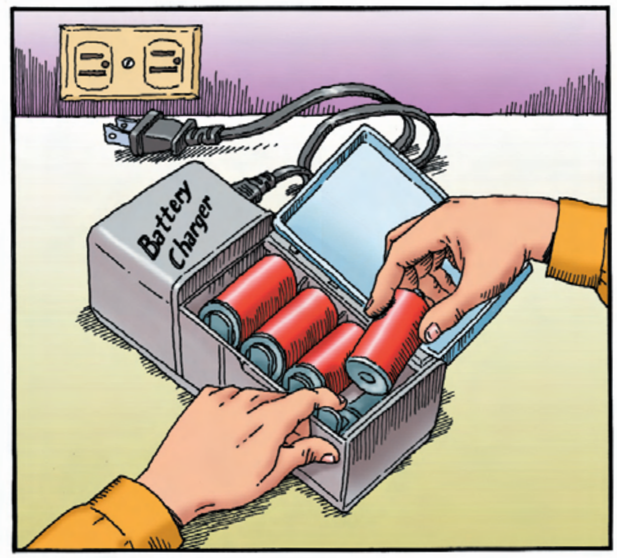

Figure 3.2 *Unplug the battery charger before adding or removing batteries. Make sure the batteries are placed correctly in the charger.*

5. After 3.0 minutes, unplug the charger, remove the battery from the charger, and test the battery with your lightbulb. Record your observations in your science notebook.

6. Leave the lightbulb connected to the battery for at least 10 minutes and record what happens during this time.

7. Now repeat Steps 4 through 6, using the small electric motor in place of the lightbulb (see Figure 3.3). Record your observations.

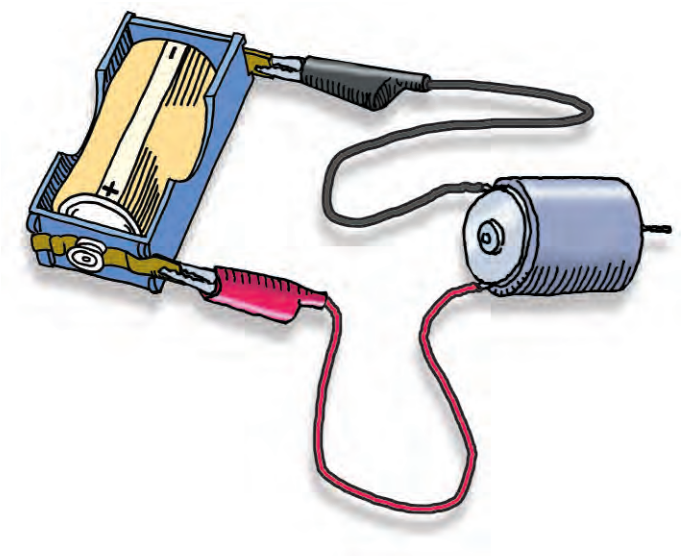

Figure 3.3 *What happens when you connect the motor to the battery?*

REFLECTING ON WHAT YOU'VE DONE

Discuss the following questions with your partner. Record your answers in your science notebook. Be prepared to share your answers with the class.

A. How was your battery different after you attached it to the charging apparatus for 3.0 minutes? Support your answer with evidence.

B. How can you explain your observation?

C. What happened when you left the bulb connected to the battery? Why did this happen?

D. What happened to the battery's energy when you connected it to the lightbulb?

E. What happened when you repeated your experiment with the electric motor?

F. From your observations, do you think the motor or the light needs more energy to operate? Give reasons for your answer.

G. On the basis of your experiences in Lessons 2 and 3, write a description of a battery in your science notebook.

Different Batteries for Different Needs

Batteries come in many sizes and shapes. Some of them are strong enough to supply the electrical energy needed to power a truck; others keep your wristwatch going. Some batteries run constantly, as in the wristwatch. Others, like the ones you put in a photo flash, just have to be ready when needed.

Regardless of these differences in size, shape, and capacity to store energy, all batteries have one thing in common. Each is a container of stored chemical energy that is available and ready to be turned into electrical energy.

It Can't Last Forever. Or Can It?

Batteries are an important part of our lives, and it would be great if they lasted forever. Unfortunately, they don't. When the chemical energy inside a battery is used up, the clock stops, the music dies, or the flashlight goes dark.

At that point, you have two choices. If the battery is disposable, you throw it away and put in a new one. Many batteries today, however, are like the battery you used in this lesson—rechargeable. You connect the battery to an electrically powered battery charger. Electric

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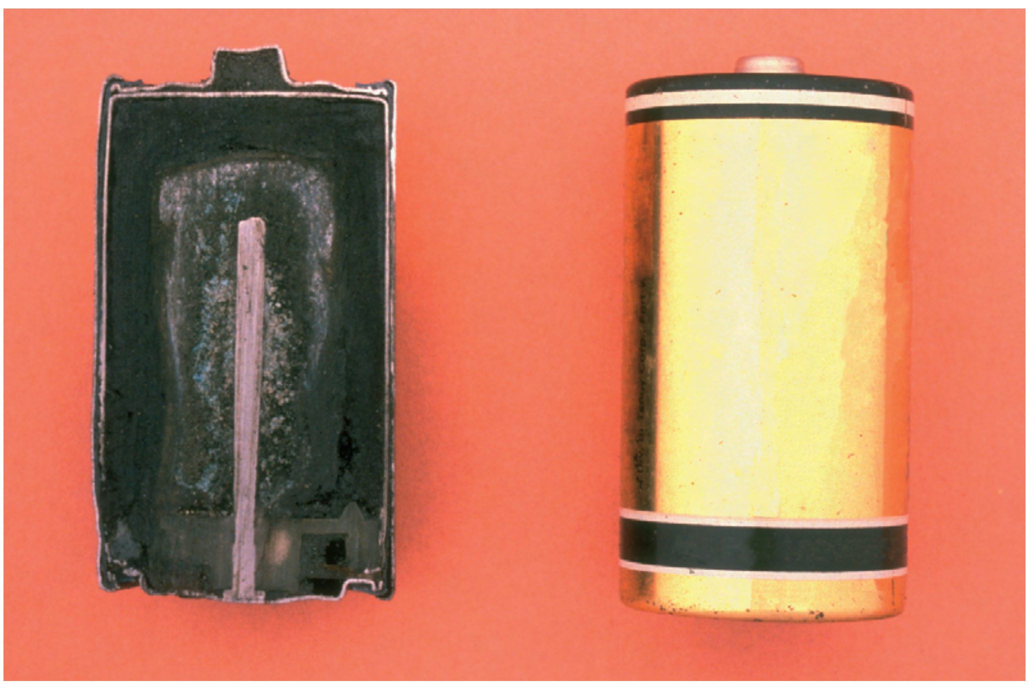

The interior of a dry cell

current flows through the battery. Electric energy changes to chemical energy. Within a short time, the battery is ready for action.

Battery Capacity

Why can some batteries store more energy than others can? The capacity of a battery (that is, how much energy the battery will store and generate) depends on what the electrodes and electrolytes are made of, and how much there is of these materials. The power needed to run a device determines how long the battery will operate before it needs to be recharged.

For example, a lithium-ion battery can store more energy than a nickel–cadmium or a zinc–manganese battery of the same size. Laptop computers, which need a steady supply of energy for a long time, operate on lithium-ion batteries. Flashlights, which are turned on for short periods, need less energy than computers do. For them, zinc–manganese dioxide batteries work fine.

Batteries have come a long way since Alessandro Volta assembled his voltaic pile in 1800. The invention of rechargeable batteries was an especially important advance. ☐

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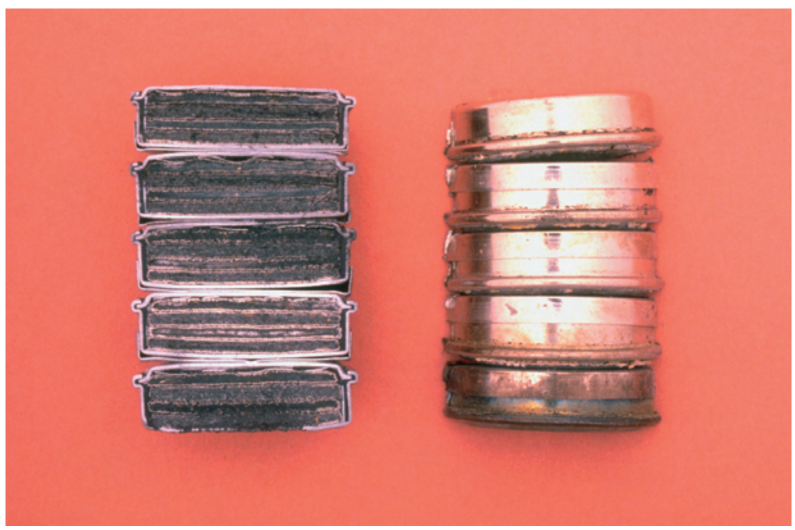
The interior of a mercury battery



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Stacking cells in series makes a battery with a higher voltage. This 6-volt battery, made of sandwiched layers of nickel and cadmium, is rechargeable.

QUESTIONS

1. What other improvements would you like to see in batteries?
2. How could these design improvements be made?