LESSON 2

Making a Battery

How many different ways do you see batteries used here?

INTRODUCTION

Batteries are used for all kinds of devices today, and they come in all shapes and sizes. Some batteries are so small they could fit on a penny. Others are too big to pick up. What is a battery? What do you need to build one? In this lesson, you will build and test your own battery.

OBJECTIVES FOR THIS LESSON

Build a battery.

Observe what happens when a battery operates.

Describe what makes up a battery.

Getting Started

1. Discuss with your partner what you know about batteries. On Student Sheet 2.1: What Do We Know About Batteries? fill in the first column, "What I Know."

2. With your partner, create a list of things you would like to know about batteries. Write your list on Student Sheet 2.1 in the second column, "What I Want To Learn." Keep this sheet until the end of Lesson 4, when you will fill out the last column.

3. During the class discussion, share your ideas about batteries.

4. Before you start to build the battery, listen as your teacher reviews the Safety Tips for handling materials.

5. Keeping a record of what you do and observe is an important part of the scientific process. Have your science notebook ready to record your predictions and observations.

SAFETY TIPS

Wear safety goggles at all times when working with a battery.

Be careful not to spill any solution from the plastic container. If some does spill, immediately wipe it up with a wet paper towel.

Wash your hands at the end of class.

MATERIALS FOR LESSON 2

For you

- 1 copy of Student Sheet 2.1: What Do We Know About Batteries?
- 1 pair of safety goggles

For you and your lab partner

- 1 blotter paper strip
- 1 zinc strip
- 1 copper strip
- 1 rubber band
- 1 clear plastic container
- 1 grain-of-wheat lightbulb with wire leads
- Copper sulfate solution
- Paper towels
- Pieces of masking tape

Inquiry 2.1
Building a Battery

PROCEDURE

1. To make sure you have all the materials you need to build your battery, compare the materials at your lab station with the items in the materials list.

2. Building your battery requires teamwork. To build the battery, follow the directions in the captions of Figures 2.1, 2.2, and 2.3. Then complete Steps 3 through 9.

Figure 2.1 *Lay the copper strip on the blotter paper as shown.*

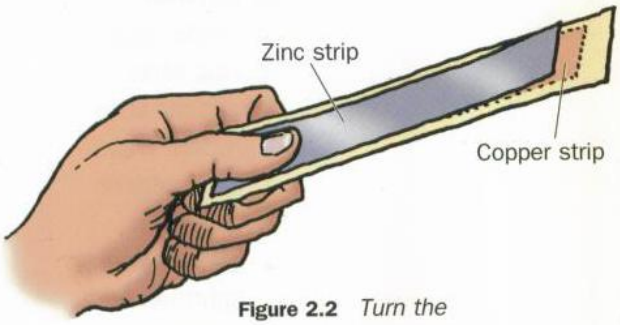


Figure 2.2 *Turn the assembly so that the blotter paper is on top and place the zinc strip on the blotter paper. Make sure the copper strip is beneath the blotter paper and does not touch the zinc strip.*

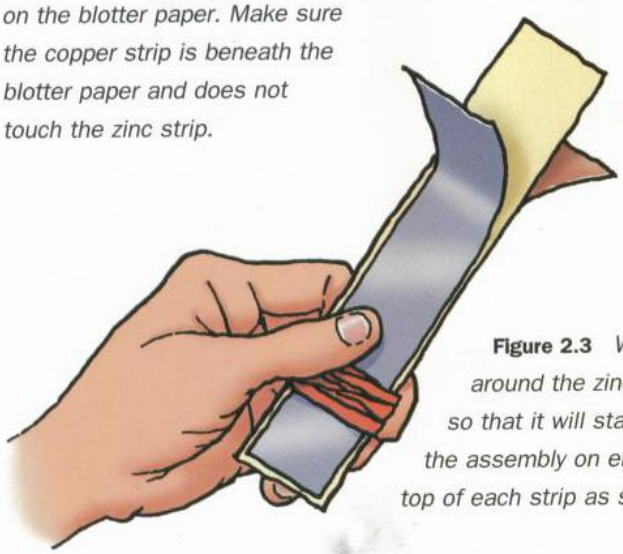


Figure 2.3 *Wrap a rubber band around the zinc–copper assembly so that it will stay together. Stand the assembly on end and bend the top of each strip as shown.*

3. Now you are ready to do some tests. Examine the zinc and copper strips and note what they look like. Draw a picture of what your assembly looks like.

4. Is what you have made a battery? How can you use a lightbulb to test whether it is a battery? Describe what you would do in your science notebook.

5. Use your lightbulb and perform your test. Figure 2.4 shows one way to do this. Record your observations.

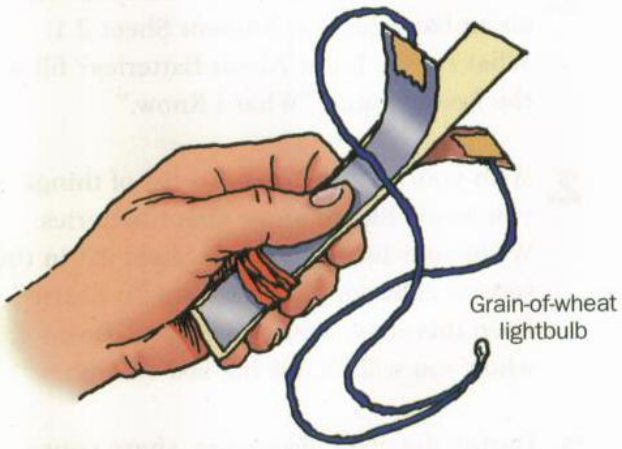


Figure 2.4 *You can attach the lightbulb to the zinc and copper strips with masking tape.*

6. Now fill your plastic container half full with copper sulfate solution.

7. Place the zinc–copper assembly in the solution and wet the blotter paper (see Figure 2.5). Use the grain-of-wheat lightbulb to test whether this setup is a battery. Record your observations.

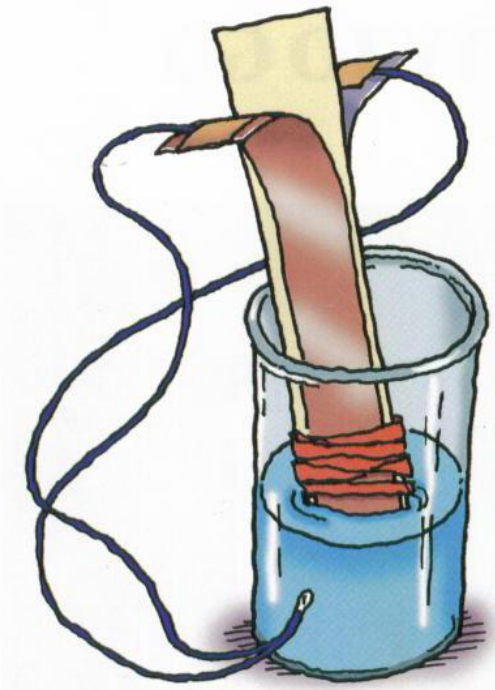


Figure 2.5 *Place the zinc–copper assembly in the copper sulfate solution.*

8. Lift the zinc–copper assembly from the solution, but keep the lightbulb attached. Look at the copper and zinc strips and record your observations of the strips.

9. Lay the assembly on a paper towel, as shown in Figure 2.6, and observe the bulb for a few minutes. Record your observations.

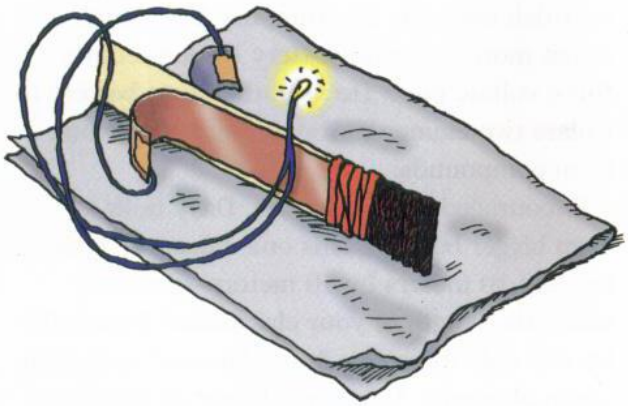


Figure 2.6 *Lay the zinc–copper assembly on a paper towel.*

10. Follow your teacher's directions for cleaning up. Be sure to wash your hands.

REFLECTING ON WHAT YOU'VE DONE

In your science notebook, answer the following questions using the observations you recorded. Then discuss your answers with the class.

A. The goal of this lesson was to build a battery. Did you succeed? Support your answer with evidence.

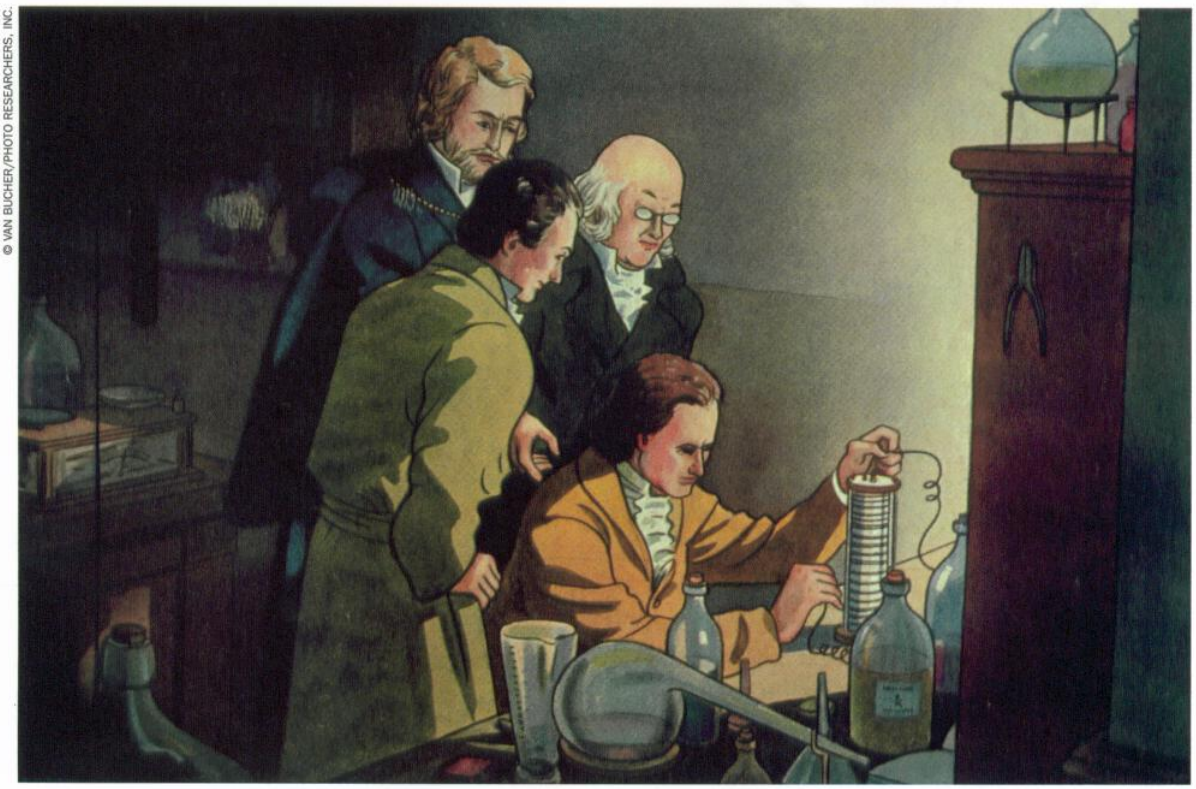
B. Describe what makes up a battery.

C. What do you conclude from your observations of the zinc–copper strips you placed in the copper sulfate solution?

D. What happened to your lightbulb after you removed the assembly from the solution? How would you explain to someone what happened?

E. In these activities, you probably noticed that the bulb was not very bright. What could you do to make the bulb glow more brightly?

BATTERIES—ELECTRICITY TO GO



An artist's depiction of Alessandro Volta demonstrating his battery to friends

Take a look at the battery in a flashlight or under the hood of a car. You'll probably see the words "1.5 Volts" or, in the case of the car, "12 Volts." These terms refer to the voltage of the battery, which determines the kinds of devices that can use the battery. For example, when you connect a 1.5-volt battery to a flashlight bulb, an electric current flows through the bulb and provides the energy needed to light it.

"Volts" and "voltage" are named for Alessandro Volta, the Italian scientist who built the first electric battery 200 years ago. Volta's battery was made of strips of zinc and copper, separated by pads that were soaked in saltwater. This crude mechanism, now called a "voltaic pile," produced an electric current.

Shortly after Volta had built the first battery, a British chemist, Sir Humphry Davy, built a much more powerful battery by connecting three voltaic piles. He used this large battery to isolate two elements, sodium and potassium, from compounds.

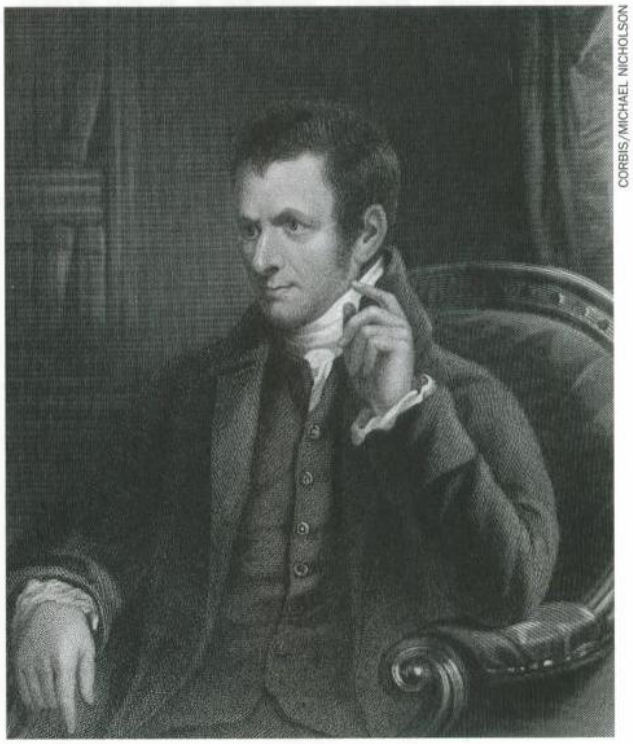
Encouraged by his success, Davy built an even bigger battery. This one measured approximately 10 meters by 10 meters—probably about the length of your classroom! Eventually he was able to use his "megabattery" to isolate seven elements. Davy's work was an important contribution to the field of chemistry.

Sir Humphry Davy built his giant battery in the basement of Britain's Royal Society. Although no one knew it at the time, Davy's

work was dangerous. Potassium and sodium, the elements he was trying to isolate, can explode when exposed to water.

Davy used the results of his experiments to create a new branch of science, called electrochemistry, which is the study of the relationship between electricity and chemical changes in matter.

Although Davy's battery worked, it wasn't practical for everyday use. Scientists continued to experiment. By the 1880s, they had designed batteries that were portable and inexpensive. Until the invention of the electric generator, batteries were the main source of electrical power. □



CORBIS/MICHAEL NICHOLSON

Sir Humphry Davy

QUESTIONS

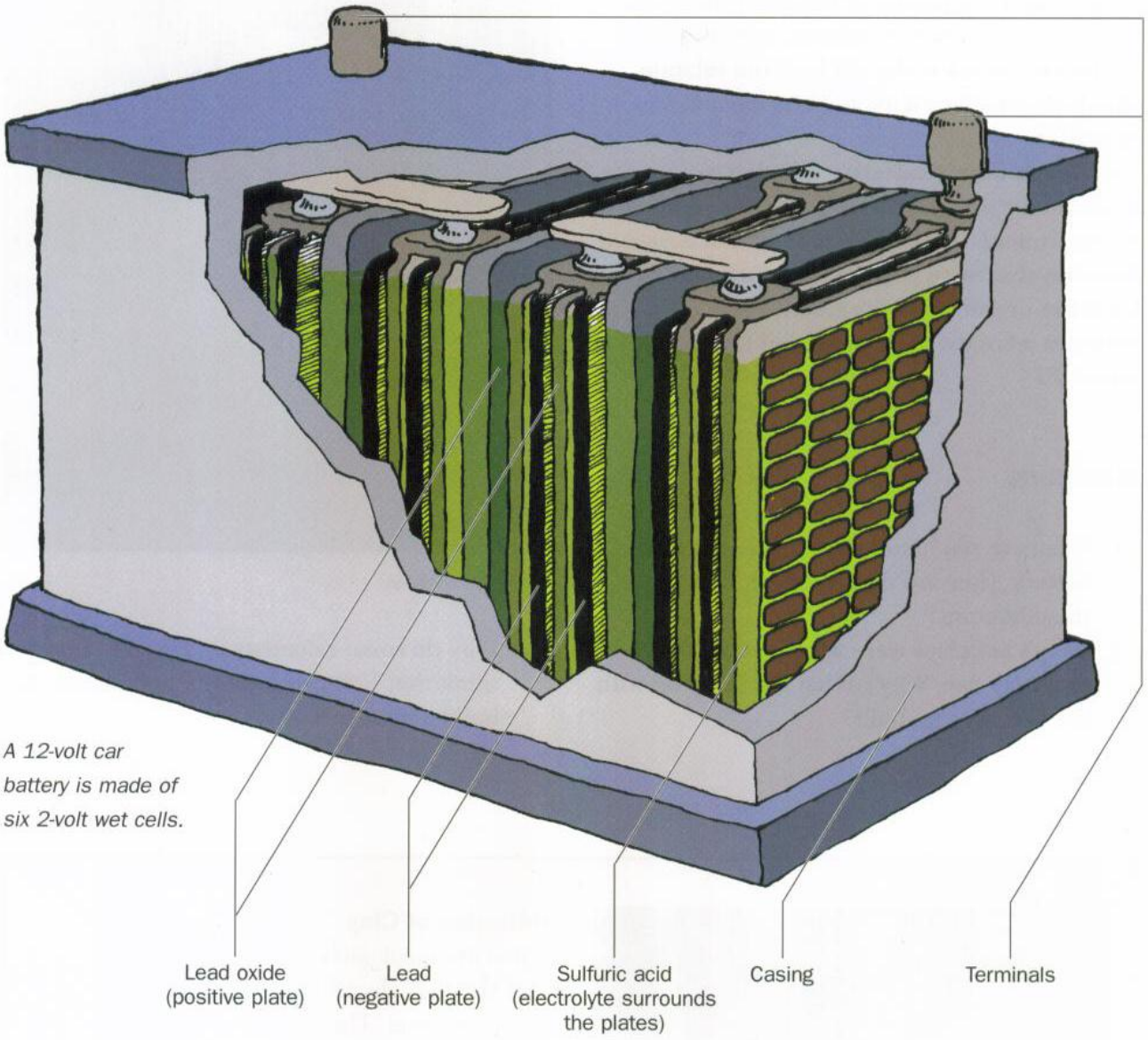
1. Compare the battery you made with Volta's battery. How are they similar? How are they different?
2. Davy's batteries were not practical for everyday use. Why? What did Davy do with the batteries he built?
3. Why do some scientists and archaeologists think that Volta was not the first person to build a battery?

COURTESY OF THE BERKSHIRE MUSEUM, PITTSFIELD, MASSACHUSETTS, USA

Batteries of Clay

Some archaeologists and chemists think that the first electric batteries may have been clay pots. The metal rods inside the pots were surrounded by a copper cylinder. When a solution was poured into the pot, it became a working battery that could generate up to 2 volts of electricity. Jewelers may have used the current to coat ordinary metals with gold and silver. The clay pots pictured here are models of those found in Baghdad. The real clay pots found in Baghdad are more than 3000 years old.

Wet-Cell and Dry-Cell Batteries



A 12-volt car battery is made of six 2-volt wet cells.

In Lesson 2, you made a battery using two metal strips, called electrodes, and a liquid, called an electrolyte. The assembly of zinc and copper strips placed in a copper sulfate solution is an example of a "wet-cell" battery. It is called "wet" because the electrodes are placed in a liquid. The copper sulfate solution was the electrolyte for your battery. The battery you made is called a cell because it is the basic building block of larger batteries. Connecting cells can make batteries that supply more voltage than a single cell. Many batteries are made by connecting cells. That's what Sir Humphry Davy did when he made his big battery.

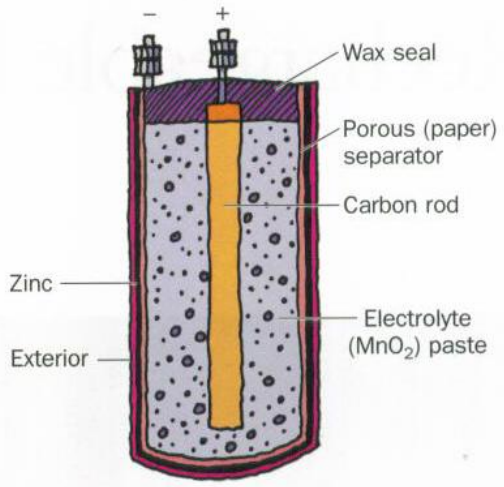
A car battery is made of wet cells. It is made of six cells (pairs of metal electrodes with a liquid electrolyte made with sulfuric acid) arranged in a row. The terminals of the

battery are connected to the first and last metal electrodes in the row of cells. Connected this way, the six cells provide enough electrical energy to start a car and to supply energy to its lights, radio, and other electrical devices.

But wet cells are not always practical. What kinds of problems would you have if you tried to use the wet cell you made in a flashlight?

The batteries built by Volta, Davy, and other scientists in the 19th century were wet cells. In the late 19th century, a new kind of battery was invented. It is called a dry-cell battery. A dry-cell battery is not really dry, but it has an electrolyte in it that is a paste instead of a liquid. The electrodes and the electrolyte paste are put in a sealed container with terminals connected to the ends of the electrodes. The paste does not spill out if the dry cell is moved around or turned upside down.

The invention of dry cell batteries made batteries portable. It made it possible to use batteries in many devices that were not suited to wet cells. Today, dry cells are used in battery-powered toys, flashlights, smoke detectors, radios, CD players, and many other devices. The diagram illustrates what makes up one kind of dry cell. Later in this module you will use dry-cell batteries to run electric motors. □



Interior of a zinc–carbon dry cell