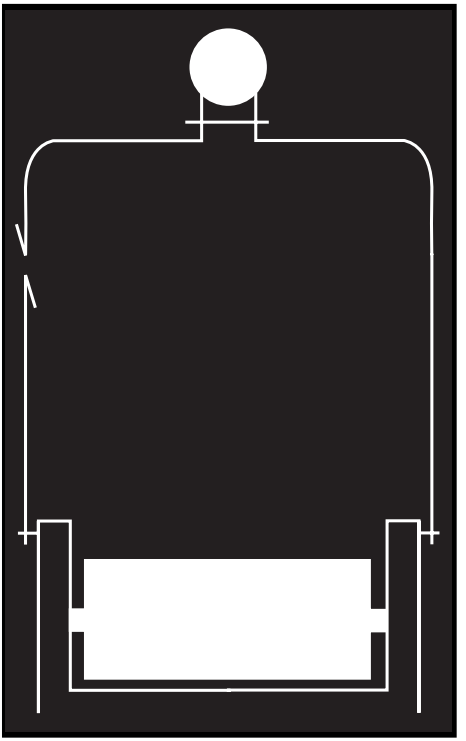


ELECTRIC CIRCUIT UNIT

65304-05

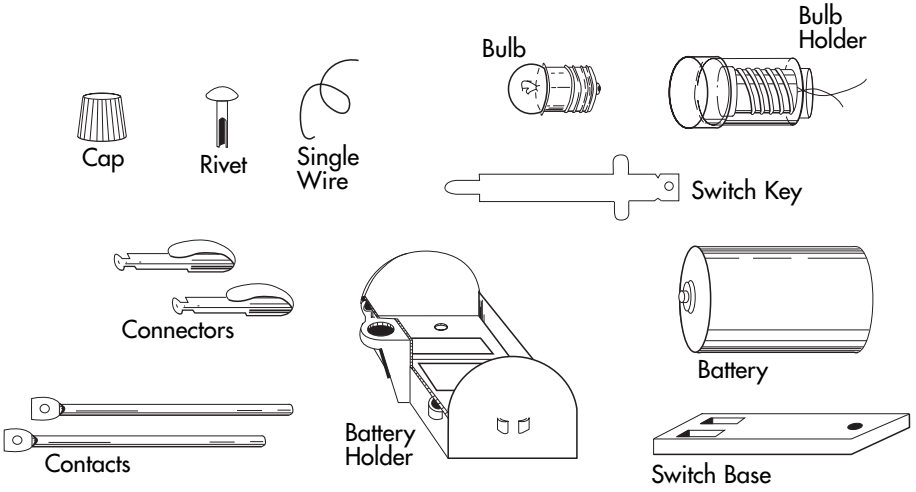
STUDENT'S WORKBOOK

By Lawrence F. Lowery

STUDENT'S WORKBOOK ON ELECTRIC CIRCUITS

INTRODUCTION

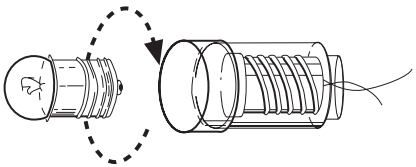
We live in an age of electricity: it works for us in our homes, schools, and industries. Using this package of materials will lead you to discover some important facts about electricity and how we have learned to make use of it.
Have you ever wondered about electricity? About how a flashlight works? Or electric toys? Before you begin exploring electricity, check the materials in the package to make sure they are all here.



Before you begin an exploration, it is a good idea to read it through so you know what is coming when you begin assembling the equipment.

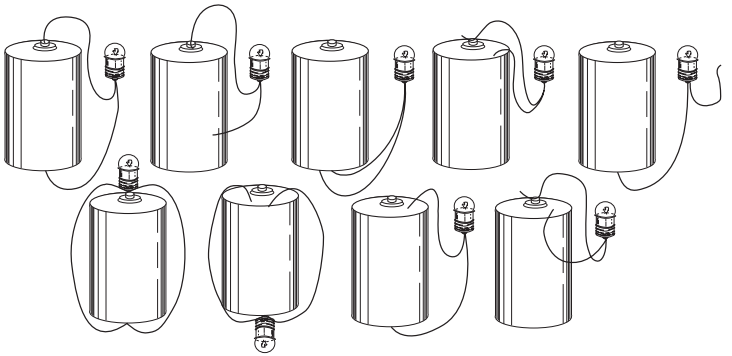
Exploration 1: Lighting a Bulb

Screw the bulb tightly into the bulb holder. Touch the battery with the bare ends of the wires. Does the bulb light? How must you touch the battery with the wires to do this? Are there more than two places to touch the wires? Will the bulb light if only one wire touches the battery?

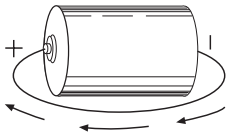


Exploration 2: Testing Connections

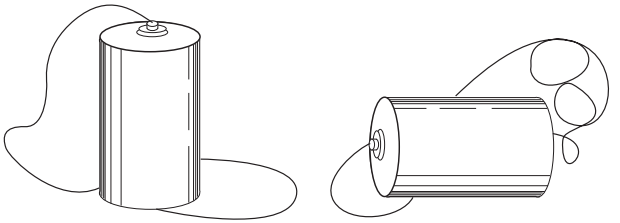
Each drawing below shows a different way to touch the battery with the wires. In which drawings would the bulb light?



Check your guesses by testing each drawing with your battery and bulb. When you touch the battery in the right places with the wires, electricity travels from one part of the battery, through the wires and the bulb, to another part. When it travels like that the path it takes is called a circuit. In the drawing below, the arrows show the circuit path made by the electricity.



With your finger, follow the circuit in each of the drawings below.

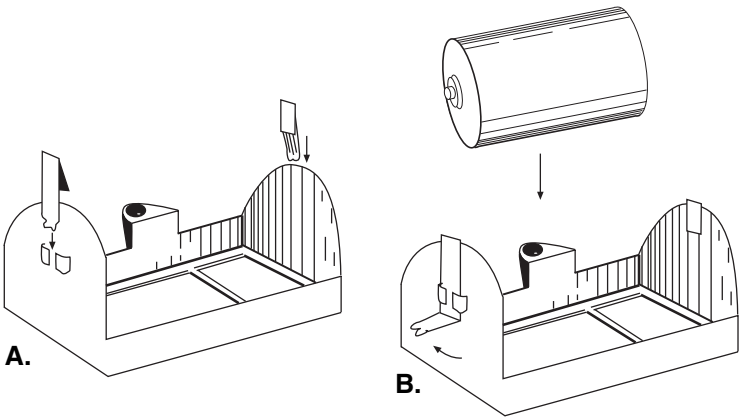


When you use a bulb in an electric circuit, the bulb lights. This is because the electricity travels through the wire in the bulb. The bulb tells you when electricity is in motion. What happens when the circuit is broken? How can you tell?

Look closely at the bulb. Draw a picture of what you see inside the glass. The wire inside the glass is called the **filament.** Do you think the filament is attached to the metal base of the bulb? Light the bulb and watch the filament at the same time. What happens to the filament? Do you think the filament is part of the electric circuit? Why?

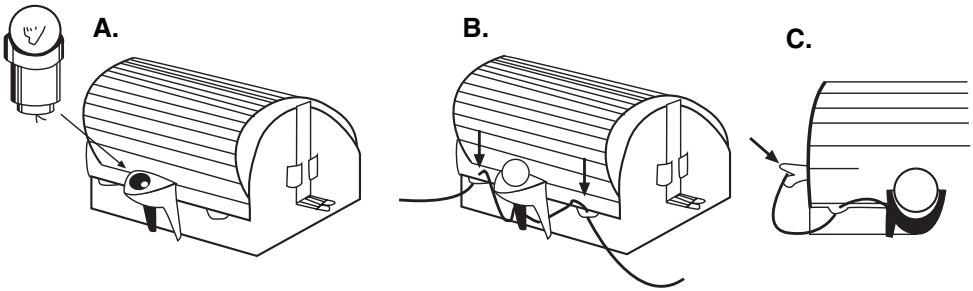
Exploration 3: The Battery Holder

The battery holder keeps the battery from rolling around, and makes it easier to attach the wires to the battery. Prepare the battery holder by slipping the connectors into the slots at each end as shown in A. Bend the ends of the connectors up as shown in B.



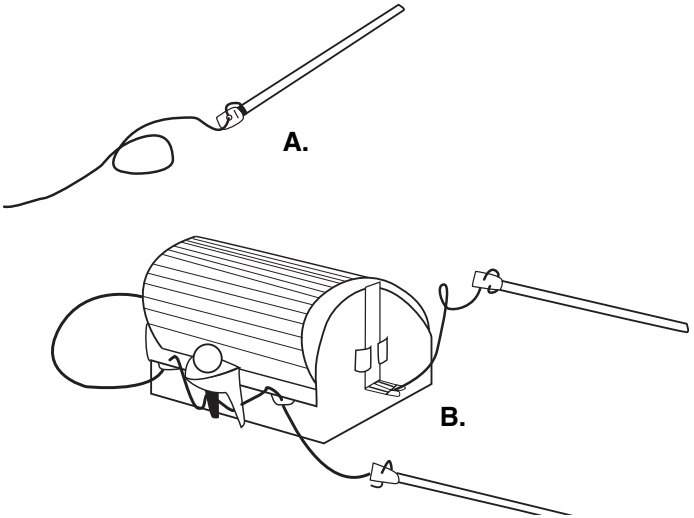
Push the battery into the holder, making sure the contacts firmly touch the battery. Now touch the bulb holder wires to the battery connectors. Does the bulb light? Why must the connector touch the top and bottom of the battery? Does it make any difference if you turn the battery around in the holder? Try it and see.

Place the bulb holder into the battery holder as shown in A. Thread the wires through the loops on the side of the battery holder as shown in B. Take one of the wires from the bulb holder and thread it through the hole in the connector as shown in C. Wrap the bare part of the wire tightly around the end of the connector.



Find one of the contacts and attach the wire from the other end of the bulb holder (see sketch B on the next page). (If you don't remember which is the connector and which is the contact, look again at the sketch on page 1.)

Find the single wire, strip 1" of the outer coating off each end, and attach one end to the second contact as shown in A. Attach the other end of the wire to the connector on the battery holder as shown in B. Check all of your attachments carefully.



Touch the contacts together: what happens? If everything is connected correctly and firmly, the bulb lights when the two contacts are touched together. Is electricity in motion when this happens? How can you tell? Can you trace the circuit taken by the electricity? When the contacts are not touching, what happens to the circuit? Does the bulb light?

Exploration 4: Enlarging the Circuit

It is possible to lengthen the path taken by the electricity in your circuit. Straighten a paper clip. Touch one of the contacts to each end. Does the bulb light? Can electricity travel through the paper clip? Have you lengthened the circuit? Hook several paper clips together and test the circuit. If the bulb doesn't light, can you find out why? Test a number of materials to see if electricity travels through them. Try a nail, a pin, a fork, a needle, an eraser, a comb, and other articles. Record the results on a chart like the one shown below.

TEST CHART I		
OBJECT	BULB LIGHTS	BULB DOES NOT LIGHT
Nail		
Pin		
Fork		
Needle		
etc.		

Exploration 5: Finding Conductors and Insulators

Objects and materials that electricity travels through are called **conductors,** and those that electricity doesn't travel through are called **insulators.** Look at Chart I again: which materials are conductors and which are insulators? Your battery holder and bulb can be used to tell which materials conduct electricity. Touch the two contacts to a doorknob: does it conduct electricity? Try other objects around the room; keep a record of your findings on a chart like the one shown below.

TEST CHART II		
OBJECT	CONDUCTOR	INSULATOR
Pencil		
Chalk		
Pen		
Lamp		
Chalk Tray		
etc.		

What objects conduct electricity? What objects are insulators? What kind of materials are conductors? What kind of materials are insulators? Are metals insulators?

Look at the wires used on your battery holder: is the plastic coating a conductor or an insulator? How can you tell? Is the metal wire an insulator or a conductor? Why is plastic put on wires? Do the electrical wires in your home have coverings on them?

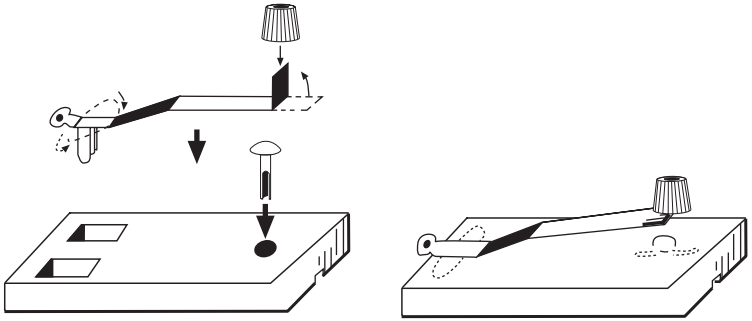
Additional Exploration

How would you find out if liquids are conductors or insulators? Are all liquids one or the other? Try some and keep a record of all your finds in a chart like the one below.

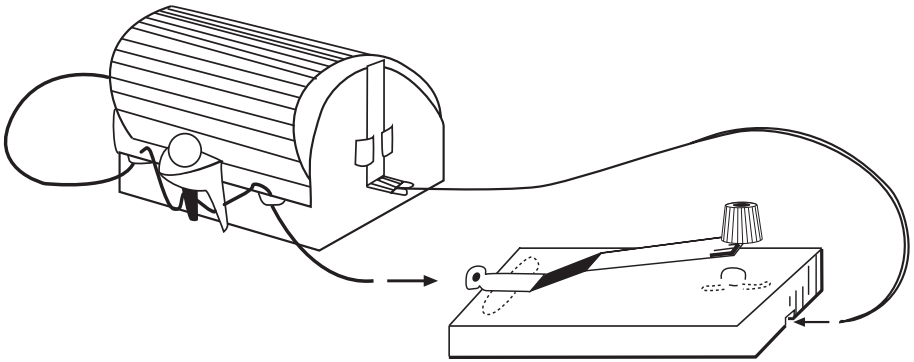
TEST CHART III		
OBJECT	CONDUCTOR	INSULATOR
Tap Water		
Distilled Water		
Salt Water		
Vinegar Water		
Baking Soda Water		
Sugar Water		
etc.		

Exploration 6: Preparing the Switch

The contacts attached to the wires are used to complete a circuit. When they touch, the bulb goes on. When they do not touch, the bulb goes off. The contacts work like a **switch.** A switch is simply an easier way to complete or break circuits. Switches are made in many ways, but the remaining pieces in the package will make a simple switch. Put the switch together by slipping the metal rivet into the switch base. Spread the tabs apart so they hold the rivet firmly in place. Attach the metal switch key to the base by bending the tabs as shown below and sliding the tabs through the two slots on the base. Bend the tabs underneath the base to hold the key in place. Slip the blue cap onto the switch key, using a little glue to hold it in place.



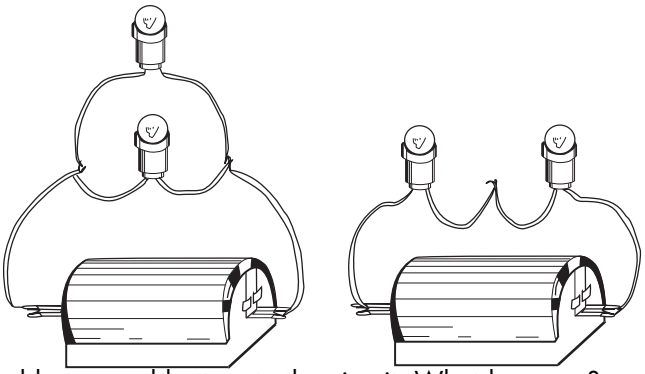
Remove the contacts from the wires on your tester. Attach one wire to the rivet and the other to the switch key. Now press down the cap so the switch key touches the metal rivet. What happens to the bulb? Release the key: what happens? Follow the circuit now that you have added the switch. At what place does it break and connect?



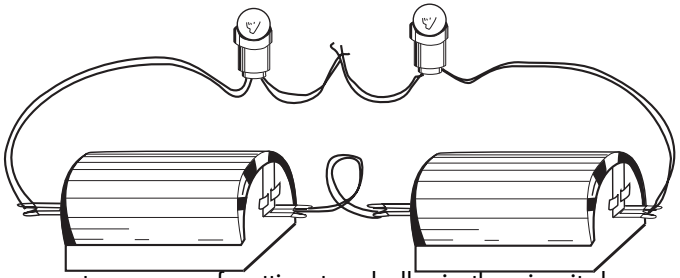
You can send light signals with your switch, bulb and battery. Pressing the switch makes a light that can be seen quite a distance at night. Look up the Morse and International Codes in an encyclopedia. Could you use this kind of a code for signaling a friend? Try it.

Exploration 7: Two Kinds of Circuits

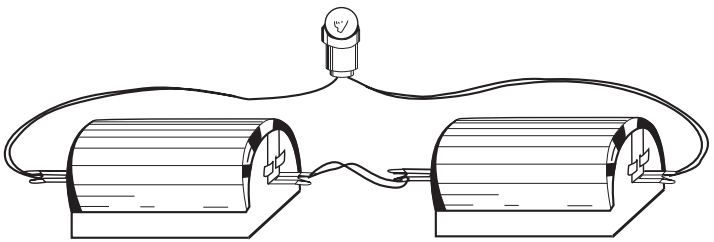
If a friend has a battery and bulb, the two of you can make more complicated circuits. How do you think you should hook two batteries together in a circuit? Try it and see if you are right. What happens if you put the batteries the other way in the circuit? What would happen if you added more batteries in the circuit? As you put more batteries together, does the bulb get any brighter or dimmer? Now put two bulbs in the circuit in one of the ways shown below. Try them all. Which way do the bulbs burn brightest?



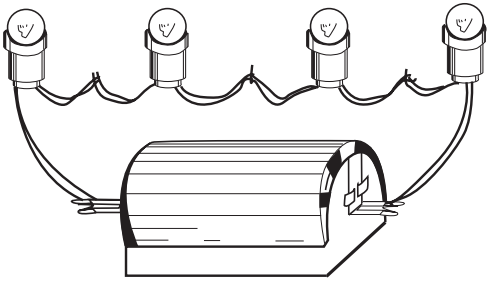
Now add a second battery to the circuit: What happens?



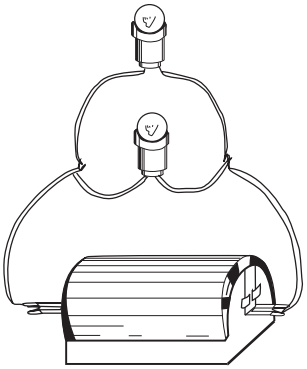
If there are two ways of putting two bulbs in the circuit, how many ways are there of putting two batteries in a circuit? Try them and find out. Look at the sketch below for one suggestion.



Look at the sketch below. What will happen if one bulb is unscrewed? This is called a **series circuit**. Can you arrange a circuit with two bulbs so that unscrewing one won't make the other go out?



Look at the sketch below. What happens when one of the bulbs is unscrewed? This is called a **parallel circuit**. Which circuit do you think is best? Why?



Additional Exploration

Obtain a flashlight. Take the batteries out and the reflector off. Can you find the contacts and connectors? Can you find the switch? Can you trace the circuit with your finger?

Dr. Lawrence F. Lowery is a professor of science education at the University of California, Berkeley. He has had extensive elementary and junior high school teaching experience, has written numerous books and made films on science and has written many articles for teachers on science instruction.

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