

A Paper-Clip Switch

BROWARD COUNTY ELEMENTARY SCIENCE BENCHMARK PLAN

Grade 1—Quarter 4

Activity 39

SC.B.2.1.1

The student recognizes systems of matter and energy.

SC.H.1.1.3

The student knows that in doing science, it is often helpful to work with a team and to share findings with others.

ACTIVITY ASSESSMENT OPPORTUNITIES

The following suggestions are intended to help identify major concepts covered in the activity that may need extra reinforcement. The goal is to provide opportunities to assess student progress without creating the need for a separate, formal assessment session (or activity) for each of the 40 hands-on activities at this grade level.

1. Ask, *What switches can you find in our classroom?* (Answers will vary. Students should mention light switches, switches that control wall outlets, and any switches on devices such as a TV set or tape player.) Ask, *What one thing do all of these switches have in common?* (They all control the flow of electric current in a circuit; they all let the current flow to turn something on and stop the flow to turn something off.)
2. Use the Activity Sheet(s) to assess student understanding of the major concepts in the activity.

In addition to the above assessment suggestions, the questions in bold and tasks that students perform throughout the activity provide opportunities to identify areas that may require additional review before proceeding with the activity.

A Paper-Clip Switch

OBJECTIVES

In this activity, students learn what a switch is, how to make one, and how to use one.

The students

- ▶ construct a switch and place it in a circuit
- ▶ trace the path of electric current through the circuit
- ▶ infer the practical importance of switches

SCHEDULE

About 40 minutes

VOCABULARY

switch

MATERIALS



For each student

- 1 Activity Sheet 39
- 1 pair safety goggles*

For each team of two

- 1 battery, D-cell
- 1 battery holder
- 1 bulb, flashlight, #48
- 1 bulb holder
- 2 electrical clips
- 1 paper clip, small
- 2 paper fasteners
- 3 pcs wire, copper, insulated, 15-cm

For the class

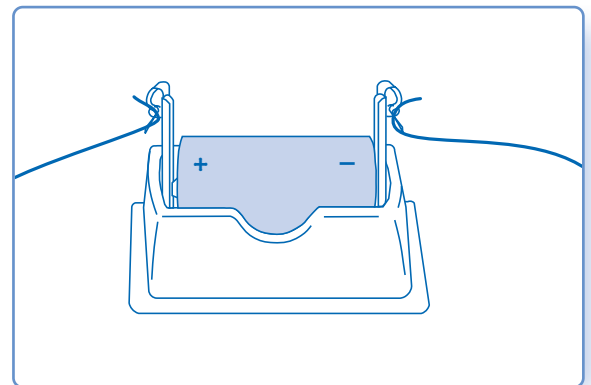
- 2 pcs cardboard, 22 cm × 28 cm

- 1 paper clip, small
- 2 paper fasteners
- 1 pair scissors*
- 1 roll tape, masking
- 1 pc wire, copper, insulated, 15-cm

*provided by the teacher

PREPARATION

- 1 Make a copy of Activity Sheet 39 for each student.
- 2 Practice putting batteries and electrical clips into the battery holders so you can demonstrate this step for students: Place the clips in first, each with the attached, curved Fahnestock clip facing the outside. Then push the battery down into the holder. **Note:** If you think your students will have too much difficulty with this task, assemble the battery holders for them beforehand.
- 3 Also practice attaching a wire to each clip so you will be able to demonstrate for students: Push in the tab on the Fahnestock clip so the loop protrudes through the hole. Push the end of the wire through the loop, then release the tab. When correctly assembled, the end of the



▲ Figure 39-1. An assembled battery holder.

wire will be held securely in place (see Figure 39-1). The two Fahnestock clips attached to each bulb holder operate in the same manner.

4 Practice inserting a bulb into the bulb holder. Insert the base of the bulb into the circular hole, then gently twist the bulb clockwise until its tip contacts the metal plate. **Note:** *It is not necessary to screw the bulb in tightly. So long as its tip touches the metal plate lightly, the circuit will be closed. If you think your students may not be able handle this task safely, attach the bulbs to the bulb holders yourself beforehand.*

5 Cut the sheets of cardboard into 6-cm × 6-cm (about 2.5-in. × 2.5-in.) squares. Each team of two will need one square. You will also need one square for your demonstration circuit. With the sharp point of a pencil, a scissors, or a math compass, poke two small holes 3 cm (about 1 1/8 in.) apart in the middle of each cardboard square.

6 Each team of two will also need one battery, one battery holder, two electrical clips, one bulb, one bulb holder, one paper clip, two paper fasteners, three pieces of wire, and access to the roll of tape.

Safety Note: *Never try—or allow students to try—any experiments using an electrical outlet. Severe injury can result. Always use the batteries supplied with the kit when carrying out these activities.*

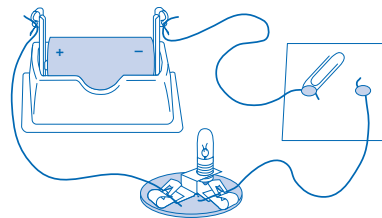
BACKGROUND INFORMATION

The battery holder, electrical clips, and bulb holder introduced in this activity are not necessary in order to complete the circuit. Students could simply hold the battery, bulb, and wires in place with their hands, as they did in Activity 37. However, using the holders and clips makes it easier to connect the circuit elements and keep them in place.

▼ Activity Sheet 39

A Paper Clip Switch

Make this circuit.



1. What happens when the paper clip touches the other fastener?

The bulb lights.

2. What happens when you move the paper clip away from the fastener?

The bulb goes out.

A **switch** is a device that opens (disconnects) or closes (reconnects) the pathway for electric current in a circuit. Switches are important because they allow us to control the flow of current in a circuit without disconnecting and then reconnecting wires or other circuit elements.

When we want to be able to turn on and off a light, a motor, or something else in a circuit, we add a switch to the circuit. When the switch is opened, the current in the circuit stops flowing, causing any bulb in the circuit to go out. Similarly, when the switch is closed, the current flows in the circuit, causing any bulb in the circuit to light.

Mechanically, moving the handle on a switch inserts or removes a conductor between two elements in a circuit, which closes and opens a circuit.

In this activity, students construct switches and then examine the role of switches in opening and closing circuits.

Guiding the Activity

- 1 Distribute the materials to each team. Hold up a battery, a battery holder, and two electrical clips. Explain and demonstrate how to assemble these parts (see Preparation step 2, page 417). Let each team assemble the battery holder as you circulate to provide help as needed.

Hold up two pieces of wire, and show students how to attach one end of each wire to a clip on the battery holder (see Preparation step 3). Circulate and provide help as needed.

Hold up a bulb and a bulb holder. Demonstrate and explain how to screw the bulb into the holder. Again, circulate and provide help as needed.

- 2 Using the materials you have just demonstrated, construct a simple one-battery/one-bulb circuit by attaching the loose ends of the wires to the clips on the bulb holder (see Figure 39-2). Have each team build the circuit with their materials.

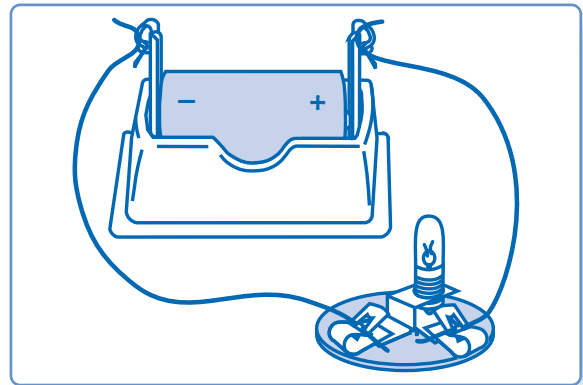
Ask, **What are the parts of the circuit you just built? How do you know that the parts make up a system?**

Additional Information

Make sure students have correctly aligned the center of each electrical clip with the center of the battery's end. Adjust each team's assembly if needed.

Make sure students do not push the wires so far into the loop that the insulation, not the exposed copper wire, makes contact with the clip. Adjust each team's wire contacts if necessary.

Safety Note: Caution students to hold the bulb by the upper part of its base, not the glass bulb, as they turn it and not to screw it in too tightly.



▲ **Figure 39-2.** The completed circuit, with the bulb lighted.

The parts are the battery, the battery holder, the electrical clips (accept students' terms for these parts), the bulb holder, and the wires. We know the parts make up a system because when they are all connected, an electric current (energy) flows through the circuit and lights the bulb.

Guiding the Activity

Additional Information

3 Ask, **How can you turn the lightbulb off?**

Disconnect the wire from one of the electrical clips on the battery holder. Ask, **Why does opening the circuit make the bulb go out?**

Ask, **Do you think that there is an easier way to open and close a circuit?**

Students should recall that they can turn the bulb off by opening the circuit somewhere.

Opening the circuit stops the flow of electric current. The flow of current is what makes the bulb light.

Someone may suggest using a switch.

4 Write the word *switch* on the board. Explain that a **switch** is a part in a circuit that makes it easy to open and close the circuit to turn something off and on.

Tell students that they are going to build a switch to put into their circuit.

5 Distribute a copy of **Activity Sheet 39** to each student, and point out the picture of the completed circuit with the switch included.

Guide students through the following steps to build the switch and add it to the circuit.

- Wrap the loose end of the disconnected wire around the head of a paper fastener.
- Push the fastener through one of the holes in the cardboard square.
- Spread the fastener's ends on the underside of the cardboard so the wire is held tightly between the head of the fastener and the upper side of the cardboard.
- Connect one end of the unused third wire to the empty electrical clip on the battery holder.
- Wrap the other end of the third wire around the head of the second paper fastener.
- Push the fastener through the end of the paper clip and then through the other hole in the cardboard.
- Spread the fastener's ends on the underside of the cardboard.
- Use pieces of masking tape to hold the bent ends of the paper fasteners in place.

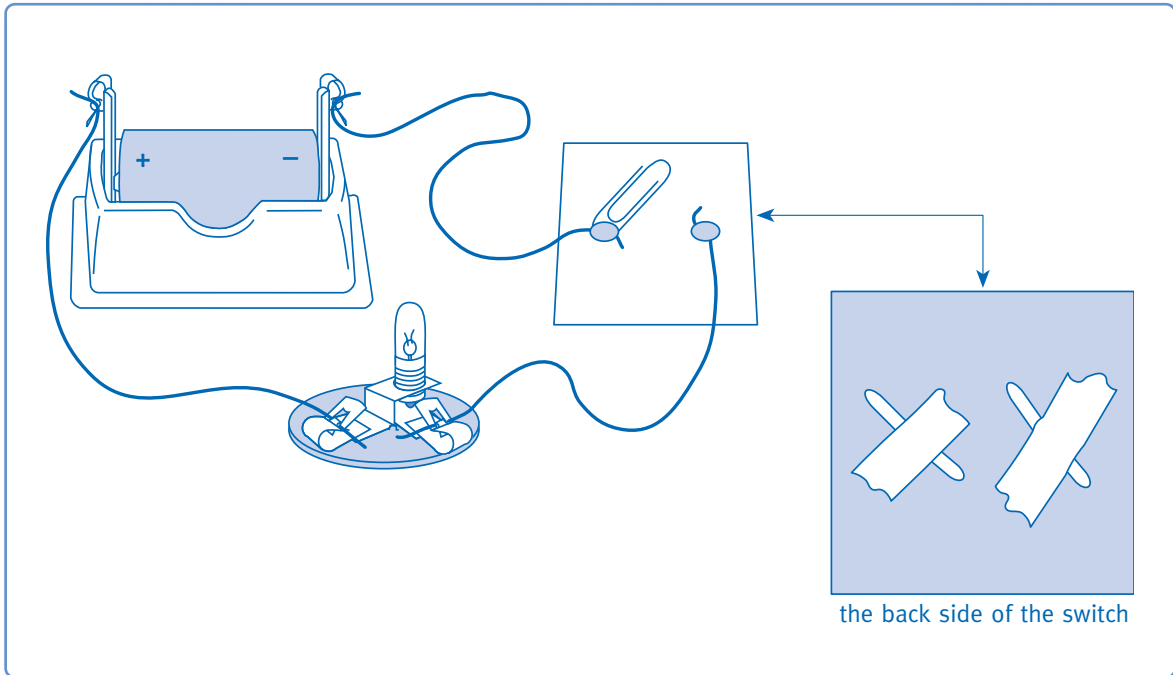
The completed circuit with the switch should look like Figure 39-3.

Demonstrate each step as you explain it, and check students' work to make sure they are doing each step correctly.

Check each team's circuit and switch to make sure all the parts are assembled correctly.

Guiding the Activity

Additional Information



▲ Figure 39-3. The completed circuit with the switch added.

- 6 Tell students to turn the paper clip so it touches the second fastener head. Ask, **What happens when the paper clip touches the other fastener?** Tell students to record this result in question 1 on the activity sheet.

Then have students turn the paper clip away from the second fastener. Ask, **What happens when you move the paper clip away from the fastener?** Have students record this result in question 2.

Ask, **Is the switch part of this system? How do you know?**

- 7 Ask, **Why did the bulb go on and off when the switch was closed and opened?**

Ask, **Why are switches important in everyday life?**

The bulb lights.

The bulb goes out.

Yes, the switch is part of the system. When it is moved back and forth, it stops and starts the flow of electric current through the circuit, and the bulb goes on and off.

The switch closed and opened the circuit, allowing the electric current to flow and then causing it to stop. The bulb went on when the current was flowing and went off when the current stopped.

They let us turn lights and other things on and off without having to disconnect wires.

REINFORCEMENT

Ask students to predict what would happen if they were to put two switches in series with one bulb. Have teams pool their switches to find out.

SCIENCE JOURNALS

Have students place their completed activity sheets in their science journals.

CLEANUP

Have students return all batteries, battery holders, electrical clips, bulbs, bulb holders, and wires to the kit. Return the switch assemblies, with a wire attached to each, to the kit.

SCIENCE AT HOME

Invite students to make a list of switches that they use in their home. How many can they find?

Connections

Science Challenge

- ▶ Give each team a battery, a bulb, a paper clip switch, and four lengths of wire. Challenge students to construct a circuit in which the bulb remains lit regardless of whether the switch is open or closed. (A circuit with the bulb in one loop and the switch in another loop will work. This type of circuit is called a *parallel circuit*.)
- ▶ Students might enjoy designing and making other types of simple switches. For example, a simple pressure switch can be made by wrapping aluminum foil around the grasping ends of a spring clothespin and taping wires to the foil. The switch opens when fingers press on the other end of the clothespin.

Science Extension

Give students an opportunity to investigate a variety of commercially available switches, including knife switches, toggle switches, and button switches. Encourage students to examine each switch carefully and try to determine how to wire it into a simple circuit to light a bulb. Give students an opportunity to demonstrate their circuits to the rest of the class.

Science and Careers

Invite an electrician or someone who teaches electrical wiring at a vocational school or high school to visit the class. Ask the visitor to bring a variety of switches, other electrical devices (such as bells and buzzers), and various types of commercial wiring to show students. Before the visit, work with students to prepare a list of questions to ask the visitor. Make sure the visitor addresses safety issues in the class discussion.

Science and the Arts

Tell students to try to image what it would be like to be part of an electrical circuit or to be the electric current flowing through the circuit. Discuss their ideas, then have the class act out a simple circuit with different components—one or more D-cell batteries, a switch, and a bulb and/or a buzzer—all connected with wires. Assign roles to different students. For example, two students standing next to each other could represent a battery, with one student being the positive terminal and the other being the negative terminal. Other students could act out the roles of a light bulb, a buzzer, and a switch. Designate several students to play the role of the electric current flowing through the circuit. Encourage students to think of clever ways to represent the roles they are playing. For example, when the circuit is closed, two students playing a switch could link their hands together, and a student playing a light bulb could raise his or her arms in the air and wave them to indicate that the bulb is lighted. When the “switch” students open the circuit, they would unlink their hands, and the “light bulb” would lower his or her hands to the side.

