



Can You Light the Bulb?

INTRODUCTION

Electrical energy is easily transferred through loops that we call circuits. This activity allows students to explore different ways to light a bulb using a mystery circuit board. The activity facilitates student understanding of the fundamental principles behind electrical circuits and how circuits transfer energy.

WHERE'S THE SCIENCE?

At its most basic, an electrical circuit is used to transfer energy so that devices can operate. As such, an electrical circuit must have the following components: (1) an energy source, (2) a closed path for energy transfer, and (3) an object where the energy is converted for use. Batteries are a common electrical energy source, with electrical generators being another common source. The path for energy transfer is usually materials that conduct electrical energy easily, such as copper wires. An electrical load is anything that is part of the circuit where the electrical energy is converted to something useful. A light bulb is a common electrical load. Another common load is the electrical motor, which runs things such as hair blowers and fans.

To work properly, a circuit must be a closed loop. In other words, energy must be allowed to be transferred from the positive or negative end of the battery (called a terminal), through the wires, to the load, and back to the other battery terminal. If the circuit is open (does not make a complete loop), then energy transfer will discontinue and the load will not operate. The circuit loop is opened when wires are disconnected from the terminal, a switch in the circuit is opened, or the circuit is short

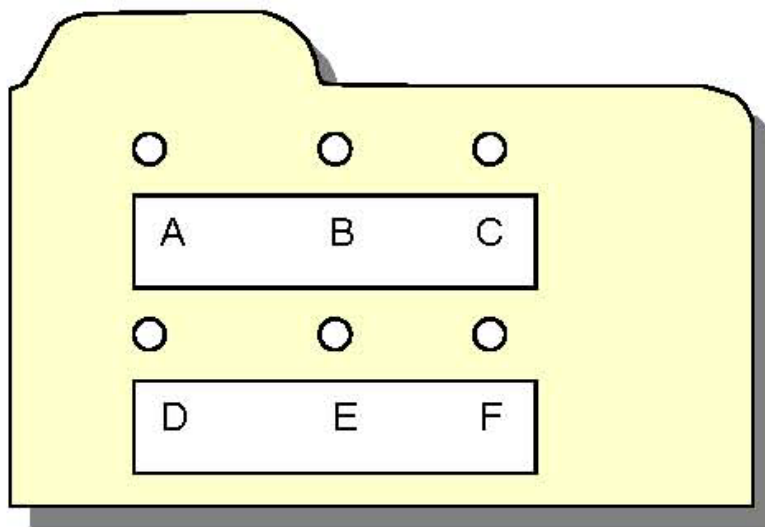
circuited (wired make a loop with no load in the loop). In the case of this activity, students try various configurations to get a closed circuit where energy is successfully transferred from the battery to the load and back to the battery. In this case, some of the energy is converted to light in the bulb.

MATERIALS

- Manila file folder
- Six (6) brads
- Aluminum foil cut into strips or 20 gauge wire segments with the ends stripped
- Flashlight bulb
- Masking tape

PROCEDURES

1. Prior to the lesson, the teacher should make the “mystery” circuit boards.
 - a. On one side of the file folder, make three holes across the top 1/3rd. Make three more holes across the bottom 1/3rd of the same side. (See figure below).



- b. Place a brad into each hole. Label each brad from A-F as shown in the figure above.
 - c. On the inside of the folder, connect two of the brads with either an aluminum foil strip or wire. For example, you can connect brads A and F.
 - d. Make one more additional connection with the aluminum or wire.
 - e. Tape the outside of the folder closed.
 - f. Create several folders with different connections.
2. At the beginning of the lesson, share a flashlight with the class and ask them how it works. You will get several kinds of answers, some which will involve electricity.
3. Have the students get out their science notebooks. Write the following questions on the board and have them respond individually to these questions.
 - a. What does the battery do in the flashlight?
 - b. Is there electricity in the flashlight?
 - c. If so, how does the electricity move?
 - d. What is going on inside the light bulb that allows the bulb to light?
4. After creating their individual responses, have the student discuss their answers with another student. Based on the discussion, have the students revise their answers.
5. The student pairs should then share their observations with the rest of the class. Make a brainstorming chart on the board with each question and start listing group ideas under each heading. *Note: Just brainstorm at this point and do not give the students the correct ideas. Just guide the discussion.*
6. Now it's time to begin the investigation. Have the students again work in pairs. Using the mystery circuit board, additional aluminum strips or wires, a 1.5 V battery (D, C, AA, or AAA), and a light bulb, challenge the students to make connections that will light the bulb.
7. After students, have investigated different ways of lighting the bulb, discuss the basic properties of an electrical circuit with the

students. Draw a diagram of a basic circuit to demonstrate what is needed to light the bulb (i.e., energy source, load, and wires).

8. Have the students draw their circuit in their science notebooks. They should label the ends of the wire with the proper brad letters that caused the bulb to light.
9. Revisit the brainstorming chart, highlight the correct ideas, cross out the incorrect ideas, and makes sure the students write a correct explanation in their science notebooks.

Additional Resources

1. The National Science Teachers Association's *Stop Faking It!* series of books has developed an excellent circuit simulator that can be downloaded onto classroom computers. The program is appropriate for intermediate students and does not require Internet access after it is downloaded and installed. The program is free and found at <ftp://ftp.nsta.org/VLabsWin/>.
2. Speaking of the *Stop Faking It!* series: Bill Robertson, the series author, has written a fabulous series book on *Electricity and Magnetism*, including a discussion of circuits. You can find out more information at http://www.nsta.org/store/product_detail.aspx?id=10.2505/9780873552363.
3. The Physics Classroom website has an accessible page that discusses basic circuit symbols and terms. The reading level would be advanced, but certainly appropriate for teachers to brush up on their content. The site is located at <http://www.glenbrook.k12.il.us/gbssci/phys/Class/circuits/u9l4a.html>.

Vocabulary

Electrical Circuit: A loop that allows electrical energy to be transferred and used. As a minimum, an electrical circuit will contain an energy source (e.g., a battery), a conductive path (e.g., wires), and a load (e.g., a light bulb).

Electrical Conductor: A material that allows electrical energy to be transferred with little difficulty.

Battery: A source of electrical energy where chemical potential energy is transferred to electrical energy.

Electrical Load: A device within a circuit that converts electrical energy to some useful form of energy. For example, a blow dryer serves the purpose of two electrical loads all at once. It converts electrical energy to thermal energy to warm air and it converts electrical energy to kinetic energy to blow the warmed air onto your hair.

Nevada State Science Standard

P5C5 Students know the organization of a simple electrical circuit (i.e., battery or generator, wire, a complete loop through which the electrical current can pass). I/L

N5B3 Students know the benefits of working with a team and sharing findings. E/L

Safety Reminder

Use only 1.5 Volt batteries. Higher voltage batteries are not necessary and may cause smaller shocks (6 Volt – 12 Volt) or injury-inducing shocks (> 12 Volts). Under no circumstances should students connect wires to electrical outlets.