Circuits and the Flow of Electricity

Lesson Overview

This lesson helps Girl Scouts learn about how electricity works within a simple circuit. Many vocabulary words must be introduced (located under things for the leader to know). This lesson uses a hands-on activity that helps students gain understanding of a circuit and how it works.

For questions or more information, send an e-mail to education@consumersenergy.com. Here are some things for the leader to know before starting this assignment.

Things for the Leader to Know

- Review how electricity travels:

  **Conductor:** Allows electricity to flow. Examples include metal and water. Our bodies also are conductors because we have water in them. An important phrase to remember is that “Electricity, People and Water Don’t Mix!”

  **Insulator:** Stops the flow of electricity. Examples include glass, rubber and special types of plastic. The rubber gloves worn by electric lineworkers are made of a special type of rubber which helps protect them from electrical shock, burn or electrocution. **NOTE:** Not any type of rubber will stop the flow of electricity, only the kind made for those who work with electricity.

  **Voltage:** The measure of pressure under which electricity flows, in this case it is the measure of how much energy or force the battery is giving.

  **Current:** The movement or flow of electricity.

  **Amp:** The measure of the amount of electrical current.

Materials Needed for the Lesson

- One copy per group of the Making Circuits work sheet
- One circuit kit for each group. Circuit kit contains:
  - One D cell battery
  - Battery holder
  - Two 1.5 volt bulbs
  - Two sockets for the light bulbs (or E-10 light bulb bases)
  - Four pieces of 6-inch insulated solid strand copper wire (18–22 gauge), with one inch of insulation removed at each end wire
Procedures

- Make the scouts aware that we will be making a circuit using a battery, battery holder, light bulb, light socket and some wire.

- Ask the questions:
  1. How can a battery give energy to a light bulb in order to create light?  
     *Answer:* Electrons carry energy and electricity is the flow of electrons.
  2. How does a circuit work?  
     *Answer:* will vary
  3. What is a complete circuit?  
     *Answer:* In order for electricity to travel to where we need it, there must be a complete circuit of electricity. A complete circuit is like a circle. Electricity starts at a particular place, travels around the circuit, and returns to the same place.

- Distribute the *Making Circuits work sheet* to each group and provide each group with a circuit kit. Allow students time to complete the activities on the work sheet and answer the questions.

- After each group has completed the activity, discuss their findings about circuits.

- Ask the questions:
  1. What kind of circuit did they complete?  
     *Answer:* A simple or complete circuit.
  2. How do you know it is a circuit?  
     *Answer:* It is a complete circuit or circle because the light bulb works and the electricity travels from a starting point, going around the circuit and back to the start.

- Have the scouts show their completed working circuit to the troop. Let them know that in this experiment, the complete circuit is something like the electrical distribution system that brings electricity to our homes. The battery produces electricity like a generating plant.

- Ask the scouts to explain the circuits by tracing the flow of energy from the battery through the course of the circuit. Remind them this activity should only be done with adult supervision.
LESSON PLAN: Circuits and the Flow of Electricity

**Michigan Curriculum Framework**

**Middle School**
- **Benchmark SCI.IV.1.MS.5** – Construct simple circuits and explain how they work in terms of the flow of current.
- **Benchmark SCI.IV.1.MS.6** – Investigate electrical devices and explain how they work, using instructions and appropriate safety precautions.

**High School**
- **Benchmark SCI.IV.1.HS.5** – Describe how electric currents can be produced by interacting wires and magnets, and explain applications of this principle.
- **Benchmark SCI.IV.1.HS.4** – Explain how current is controlled in simple series and parallel circuits.

**Lesson Outcome**
The student will apply understanding of current electricity to design a circuit and describe its workings.

**Rationale/Purpose for Lesson**
To understand current electricity, many vocabulary words must be introduced. The first part of this lesson uses a hands-on, problem-solving activity that helps students define the vocabulary terms and demonstrate the terms’ relationships. After gaining foundational understanding, students create their own circuits.

**Resources/Materials Required**
- 12 small balls (such as tennis balls or other soft balls)
- Copies of “Making Circuits” handout
- One circuit kit for each group. Circuit kits contain one D cell battery, battery holder, two 1.5 volt bulbs, two sockets for the light bulbs (or E-10 light bulb bases), and four pieces of 6-inch insulated solid strand copper wire (18–22 gauge), with one inch of insulation removed at each end wire. Materials for circuit kits can be purchased at a local hardware store.
- Paper to record observations

**Introduction**
- Ask two student volunteers to go to the front of the classroom. Assign one student the role of “the battery” and the other student the role of “the light bulb.” It may be helpful to have each student stand by the chalkboard with a picture of his or her role (the battery or light bulb) nearby.
- Ask students, How can the battery give energy to the light bulb in order to create light? Provide “the battery” with a basket of balls. Explain that the balls represent Circuits and the Flow of Electricity

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the **electrons** of an atom. Draw a diagram of an atom and discuss the negative charge of electrons. Explain that electrons carry energy and it is the flow of electrons that generate electricity.

- Have “the battery” toss the balls to the light bulb. Now the light bulb has been supplied energy to generate light.

**Procedures**

- Once “the battery” has thrown all of the balls to “the light bulb,” the supply of energy to the light bulb is exhausted and no more light can be generated. Ask students, How can the light bulb be lit for a longer period of time? Possible answers:
  - Have more balls
  - Have the light bulb return the balls to the battery quickly
  While the first answer would still work for only a limited time, the second answer introduces the term **circuit**. A circuit is a complete path; in this case the path is completed when the balls are returned to their starting point and can then be given more energy and used again.
  - Ask students, How could the light bulb give off light that is brighter? Possible answers:
    - Have each ball carry more energy by making the balls bigger. (In this case, using basketballs for example.) However, in an atom, it is easier to move the small, negatively charged electrons than the larger, positive charges.
    - Throw the ball harder. This introduces the term **voltage (V)**. Voltage is the measure of pressure under which electricity flows; in this case it is the measure of how much energy or force “the battery” is giving each ball. If the same number of balls are thrown, but each ball is given more force or energy, more power will be sent to the light bulb.
    - Throw the balls faster; send more balls to the light bulb per second. This introduces the terms **current (I)** - the movement or flow of electricity, and **amps** - the measure of the amount of electrical current. Since the electrical current is how many electrons pass by each second, if we send twice as many electrons or balls each second, we will send twice the energy.
    - Throw the balls harder and faster. This introduces the equation of **total power (P)**, which is the product of current and voltage. \[ P = I \times V \]. In this case, the total power would be number of balls thrown multiplied by how much energy each one has.

- Distribute the “Making Circuits” handouts and provide each group of three or four students with a circuit kit. Allow students time to complete the activities on the handout.

**Closure**

- Have students show their completed working circuits to the class.
- Ask students to explain the circuits by tracing the flow of energy from the battery.
through the course of the circuit. Have them either present this explanation or write it.

Extension

☐ Pose the following question to students: Will the light bulbs in the parallel circuit or the series circuit burn brighter?
☐ Have students test their predictions. Ask students if their predictions were correct and to explain the results of the test.
☐ After a simple circuit is constructed, investigate electric insulators and conductors by completing the “Insulators and Conductors” lesson.
Materials in the circuit kit

- One D cell battery
- Battery holder
- Two 1.5 volt bulbs
- Two sockets for the light bulbs (or E-10 light bulb bases)
- Four pieces of 6-inch insulated solid strand copper wire (18–22 gauge), with one inch of insulation removed at each end wire

Directions

Simple circuit with single light bulb:
1. Using two wires, connect one end of each wire to the light bulb base.
2. Connect the other end of each wire to the battery, unless this has already been done for you.
3. Record what happens. Does the light bulb light? Where does the energy flow? Describe and illustrate the flow of electrical current from the battery through the wires and to the bulb.
4. Using your circuit, demonstrate how switches must work to turn lights on and off. Draw a diagram of what the circuit would look like if the switch was in the “off” position.

Parallel circuits:
Parallel circuits are circuits in which electrical current from the battery flows with equal voltage into two or more bulbs. In this type of circuit, electricity can flow through more than one path.

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5. To make a parallel circuit, you will need two more pieces of wire, an additional light bulb and socket. Connect one end of the two new wires to the new light bulb. Connect the other ends of the two new wires to the first light bulb that is still attached to the battery.

![Image of a parallel circuit](image.jpg)

6. Record what happens with this type of circuit. Do both light bulbs light? What happens if one light bulb is unscrewed from its socket? Why?

**Series circuits:**
Series circuits are circuits in which electrical current from the battery flows through one bulb and then through another bulb. Electricity in this type of circuit can only flow in one path.

7. Rearrange the position of the wires and light bulbs in your circuit to create a series circuit. You will need three pieces of wire (only one if the battery holder already has one attached to each side). Connect one end of the wire the battery is attached to at the end of the first light bulb. Connect one end of the second piece of wire to the first light bulb and the other end of the wire to the second light bulb. Connect the other end of the piece of wire attached to the battery to the second light bulb.
8. Record what happens with this type of circuit. Do both light bulbs light? What happens if one light bulb is unscrewed from its socket? Why?