ELECTRICITY

Teacher Notes

FOURTH GRADE BACKGROUND

- Performed electricity experiment using BOCES kit; built a flashlight and some serial and parallel circuits
- Fourth graders do know that electricity flows, and you can go over how an electron flows in a circuit
- Students know that batteries have positive and negative terminals, but don't know what wing nuts are
- Students know about conductors and insulators

PREVIOUS LESSON REVIEW

- What did you about density learn last month?
- Review the concept of properties- what have we explored (mass, density, volume, color, texture)? We will explore the electronic properties of materials, such as whether they are conductors or insulators.

INTRODUCTION

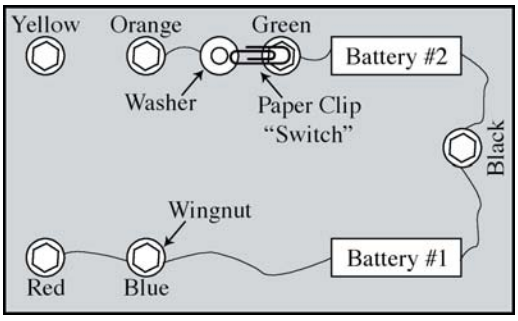
What happens when the power goes out? When we turn off a light? Why are downed power wires so dangerous? In this lesson, we will be talking about the conductive and insulating properties of materials.

Electrons are negative charges that move through matter in one direction, much like a stream of water in a pipe. This current electricity must move along a closed path, or circuit, that leads back to its starting point. Thus, a closed circuit is shaped like a loop or circle. Circuits must have a current source such as a battery, generator, or power plant that produces a potential difference of electrical energy. The potential difference is measured in volts and causes electricity to flow from the source to the device and back to the source. If the circuit isn't closed, electricity will not flow.

The requirements for a complete closed circuit are shown in building a flashlight using wire, a battery, and a light bulb. When these materials are connected correctly, they make a pathway for electricity (a closed circuit). Oppositely, when we disconnect the wire, we break the circuit and no electricity flows. In that case, we say that the circuit is open. You close a circuit when you turn on a light and open it when you turn off a light.

The atoms in a conductor don't have a tight hold on some of their electrons, and so they can flow freely through the material. Metals such as copper, silver and aluminum, are good conductors of electric current, which flows through them easily. Because water also conducts electricity, we need to keep electrical items like blow dryers, curling irons, etc. away from water. Otherwise, we will get electrocuted. Ouch!

If electricity cannot flow naturally through a certain kind of matter, then it is called an insulator. The atoms of an electrical insulator have such a tight hold on their electrons that few, if any, flow through the material. Some insulators are air, paper, wood, and plastic. Insulators can be used to protect us from electricity, such as the plastic coating on a wire does.



In our experiments, we will be using a circuit board, pictured to the left. We will explore closed and open circuits using a Christmas light bulb and household items that are conductors or insulators. If the bulb is connected in such a way that we can trace a complete path with our fingers, then the bulb will light up. If there is even the tiniest gap, the electricity can't flow and the bulb will stay off.

DISCUSSION THOUGHTS

What things do we use that require electricity?

VOCABULARY

- **Electricity**: electrons that flow through wires (like water flowing in a pipe)
- **Electron**: a small particle that carries a negative charge
- **Insulator**: a material that does not allow electrons to pass through it

- **Conductor**: a material that allows electrons to flow through it
- **Circuit**: a road or path for electrons to flow
- **Current**: the amount of electrons flowing through a circuit

ACTIVITIES

- **Worksheets**
  - Students complete the Electricity Worksheet. You can use the overhead to work together.
  - Materials:
    - 25 Electricity Worksheets

- **Complete Circuits**
  - Have the students work in pairs and hand a circuit board to each pair. Using the light bulb, check to see which pairs of colored dots will allow the bulb to light up. For example, if they connect the bulb to the green and black wing nut, it will light up; however, it will not light up if they connect the red and yellow wing nuts. Discuss what is required in order to have a complete (closed) circuit. Stress that if the circuit is open, the light bulb won't light.
  - Objective: To learn what is needed for a complete circuit and what causes broken circuits
  - Materials:
    - 15 Circuit Boards
    - 15 Light Bulbs with Leads

- **Conductor or Insulator?**
  - Distribute the Electricity Experiment worksheet to each student. Explain what makes a material a conductor (i.e., "loose" electrons in a metal) or an insulator. One at a time, hold up each item and have students make a hypothesis about whether the material will be a conductor or an insulator. Ask how they can test for this property using their circuit board and a light bulb. Once you work it out with the students that the materials can be placed in the switch, hand out the bags of materials and let them collect and record their results.
  - Objective: To compare conductors and insulators and explain how they are used
  - Materials:
    - 25 Electricity Experiment Worksheets
    - 15 Circuit Boards
    - 15 bags of objects (wood, penny, rubber, white plastic, paper clip, hair pin, card, aluminum foil, wing nut, and silver plastic)

- **Secret Circuits**
  - Using the circuit board, wires, and the bulb, have pairs of students find the conductive paths on secret circuit boards. There are 8 metal contacts on the top of the board; on the bottom, there are metal wires that connect two of the eight leads. There are two sets of connected electrodes. Using the circuit board and the light bulb, the students should form a complete circuit to determine which leads are connected. Have them connect one lead of the bulb to the green wing nut and one end of the free wire to the blue wing nut; the opposite end of the free wire and bulb can test the eight metal contacts. Students that methodically test the leads will be more efficient that those who randomly test contacts. Students should record the secret circuit board number on the worksheet and then draw lines to show which metal leads are connected.
  - Objective: To continue learning about complete circuits
  - Materials:
    - 25 Secret Circuit Worksheets
    - Secret Circuit Boards (A-R)

CONCLUDING THOUGHT

Talk about safety. Why is it important to have insulating plastic on wires? Why are there warning tags on all household electronic items? What can we do to keep ourselves safe when using electric devices?