Lesson 5: Signs of Safety

Overview

After taking a closer look at the materials making up the components of familiar light emitting devices, students extend their understanding of conductors and insulators by identifying potential electrical hazards, discussing what makes them hazardous, and suggesting what can be done to prevent such hazards.

Teacher Background

Power lines, wires, and metals are likely to come to mind when thinking about strong conductors of electric currents. The human body, made up of large quantities of water and salt, is also capable of conducting an electric current. In general terms, humans are poor conductors of electricity but strong electric currents can pass through the body, causing serious injury or death. Electricity passing through the body can cause the heart to go into cardiac arrest; muscle, nerve and other body tissue can be damaged due to electrical current; and burns can occur where the body contacts an electrical energy source. The severity of injury depends on several factors including the voltage of electricity, how the current travels through the body, the state of the person's overall health, and how quickly medical help is received following electrocution.

Children, construction and utility workers, pets, and livestock are particularly vulnerable to electrocution. This lesson allows students to apply their knowledge of conductors and insulators to everyday items and situations and recommend precautions that should be taken when using electrical energy. As noted in the previous lesson, humans have used their knowledge of conductors and insulators to deliver electrical energy safely to millions of people worldwide. Electrical energy is an essential in today's modern world. As consumers of electricity, students should be made aware of electrical hazards in and around their homes, businesses, and schools and take simple measures to use electrical energy safely.

While not a focus of this lesson, students may be aware of such things are fuses, circuit breakers, power strips, and other devices that automatically shut off current to various devices when the electrical current is too high. Large power overloads are dangerous, potentially destroying electrical equipment or causing a fire. The simplest circuit protection device is a fuse. Fuses are an early

technology and date back to the 19th century. A fuse is a small piece of metal across which electricity must pass. During normal levels of electrical flow, electricity passes across the fuse unobstructed. However, when overloaded, the small piece of metal melts, interrupting the flow of electricity. Fuses must be replaced after the electrical problem is fixed.

Circuit breakers are a more modern invention that improved upon fuse technology. Similar to fuses, circuit breakers are electromagnetic switches that turn off or "trip" when the electrical flow becomes too high. Unlike fuses, circuit breakers can be reset after the electrical problem is corrected.

There are a number of different types of power strips available to consumers today. Some are designed to keep electronic devices from receiving power surges while others aim to protect against overloading electrical circuits. Students may be interested in learning more about these sorts of devices aimed at protecting wiring in homes from overheating and causing a fire and keeping appliances operating safely.

Key Ideas

- A complete path to and from the source (loop) is needed for the electric current to flow.
- Current electricity can exist in and move through a conductor. A conductor is a material that allows an electric current to pass through it.
- An insulator does not allow electric current to pass through it easily.
- Electrical energy can be used safely in our homes, businesses, and schools, but it is not without risks. By understanding how electric current travels, people can minimize their chances of being seriously injured or killed from electrical hazards.

Lesson Goals

Students will:

- recognize the applications of conductors and insulators in everyday devices and situations.
- identify electrical hazards in homes, businesses, and schools.
- suggest ways to prevent serious injury and death from electrical hazards.

Vocabulary

electrocute: to kill by electric shock

hazard: something that is dangerous and can cause harm or serious

short circuit: the action of an electric current flowing along a path other than the one intended

Preparation

- Become familiar with the electrical safety handout.

Materials

Item	Quantity
Flashlight with batteries	1 per group
Incandescent flashlight bulb	1 per group
Extension cord	1 per group
Desk lamp	1 per group
Scientist's Notebook	1 per student
Safety Sign examples (optional)	1 set per class
Poster or large sheets of paper	1 per student
Markers, colored pencils, crayons	1-2 sets per group
Electrical Hazards Handout: http://www.dolceta.eu/malta/Mod4/IMG/pdf/TB_FINAL_Secondary_Resource_10-12_Worksheets_1-3_REV.pdf	1 per student or pair

Time Required: 1 or 2 sessions

Connection to *Benchmarks for Science Literacy (BSL)* and *National Science Education Standards (NSES)*

- Electricity in circuits can produce light, heat, sound and magnetic effects. Electrical circuits require a complete loop through which an electrical current can pass. NSES B(K-4)
- The potential for accidents and the existence of hazards imposes the need for personal injury prevention. Safe living involves the recognition of risk in personal decision. NSES F (5-8)
- Materials vary in how they respond to electrical currents, magnetic forces, and visible light or other electromagnetic waves. new BSL 4D/M9(6-8)

Teaching The Lesson

Engage

1 Review of conductors and insulators.

Briefly review which materials are good conductors of electric current and which materials are good insulators of electric current. Ask students if they think humans are conductors or insulators of electric current. (Humans are conductors of strong electric currents. The electric current in the battery and bulb circuit was not very strong. Electric current in household wires and power lines is strong.)

Introduce the focus of today's lesson by explaining to students that people use their knowledge of how electric current travels and of conductors and insulators to develop safe ways to use electricity.

Ask students to write the following focus question in their notebooks and provide two examples in response to the question:

How do you think people use their knowledge of electric currents, conductors and insulators to use electricity safely?

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Explore

2 Identify conductors and insulators in components of light emitting devices.

Explain that students will take another look at some items that emit light and think about how people have used their knowledge of circuits, conductors, and insulators to design light devices that humans can use without getting hurt. Provide small groups of students with a bulb, battery-operated flashlight, extension cord, and (desk) lamp. Have each student in the group select one item to examine more closely to find out what materials direct the electric current (conduct) to the desired parts and what ones prevent unwanted or dangerous electric current from traveling. Ask students to make a labeled diagram in their notebooks of the item they select and to describe what conductors and insulators they observe in the item. Students share their findings with others in their group, focusing on what materials the items had in common as conductors and insulators. (Metal wires are coated with plastic and bulbs have metal sides and bases separated by ceramic or rubber.)

Reflect And Discuss

3 Discuss the importance of conductors and insulators in electrical safety.

Using one of the items students examined, ask them if the item would be functional without a particular insulating or conductive part. For example, if the plastic coating were removed from the extension cord, would an electric current still flow through it? (Yes, the cord would still allow electric current to flow but without the plastic covering the electric current could come in contact with other materials that are conductors, allowing electricity to pass through other materials that we may not want it to pass through. Students may also recall from their earlier experience with the "uncovered" foil wires that uncoated wires become quite hot. Exposed wiring can cause fires if they are near materials that can ignite.)

4 Discuss the role of the electrical pathway to electrical safety.

Make note that there are two types of dangers associated with electricity:

1) Electric current flowing through a person – People are conductors and if they become part of the electric current pathway, they "complete" the circuit, and current will flow through them. If the current is strong enough, it can cause serious injury or death.
2) The presence of dangerous amounts of strong electric current – Having too much current can cause things to overheat and start fires. This is why exposed wiring and short circuits are electrical hazards.

> **Note:** *Students may have heard the term "short circuit" and may have experienced a "short circuit" when working with the batteries and bulbs in earlier investigations. The term short circuit refers to the flow of electric current along a pathway that is different than the one that was intended. This pathway bypasses the rest of the current and can allow too much current to flow and produce too much heat, causing a fire.*

5 Identifying electrical hazards.

Students will use their knowledge of conductors, insulators, and electrical pathways to identify indoor and outdoor electrical hazards. Clarify what is meant by a hazard- a source of danger and, in this case, one that involves electricity.

Provide each student with a drawing(s) that depict indoor and outdoor electrical hazards. This can be found at: http://www.dolceta.eu/malta/Mod4/IMG/pdf/TB_FINAL_Secondary_Resource_10-12_Worksheets_1-3_REV.pdf (Answers are included for reference, if needed).

Students work in pairs to identify and describe why a particular activity or situation is hazardous and suggest what can be done to prevent the hazard. Students record this information in their scientists' notebooks. It may be helpful to provide suggestions as to how students might organize their notebook entries. For example, suggest a chart with one column for identifying the problem, one for explaining why the activity/situation is hazardous, and one for suggestions for fixing/avoiding the situation.

Have students share what they identified, why they think it is hazardous, and their suggestions for preventing those types of problems.

> **Note:** *Alternatively, this activity could be done by visiting Alliant Energy for Kids' virtual indoor and outdoor electric safety house. As the user moves the mouse over the various parts of a typical home, various electrical hazards are highlighted. If students have access to computers, suggest that students review the site in pairs. If only one classroom computer and an LCD are available, consider reviewing the site as a class.*

6 Bring lesson to a close.

Publicize electrical safety suggestions. Summarize students' safety suggestions by either:

1) Creating a class list of precautions people should follow to prevent electrical hazards that can be shared with others **or**
2) Having students each adopt one safety issue and create an electrical safety message poster or public safety slogan. Ask students to explain why they chose a particular hazard and how it relates to what they know about electrical circuits, conductors, and insulators **or**
3) Having pairs of students create 3 sided "table tents" depicting an electrical safety message that could be displayed on cafeteria tables for a period of time.

Extensions

Student may:

- go on a scavenger hunt to find different types of electrical safety devices, including circuit breakers, automatic shut off appliances, outlet covers, ground fault circuit interrupters (GFCI) near sinks and tubs, surge protectors, etc., and research out how they work. Investigate what it means to be a "UL listed" product.
- invite a guest speaker, such as an electrician or utility worker to describe the precautions they take when they work. Encourage the speakers to share special equipment and protocols they follow to ensure safety.
- examine common "signs" provided by the teacher that warn of electrical hazards and determine what the message is trying to convey and why the item or situation referred to is an electrical hazard.

Connection to Maine Agencies

For areas served by Central Maine Power contact: Brad Kaherl at 207-377-4599 for the Safety City Presentation. The target audience for an electrical safety presentation is Grades 4-6. It is suggested that, before contacting CMP, teachers check to see if their school has already scheduled a presentation. Schools receive a brochure in September describing the program. Areas covered: Bangor and north; Augusta – Portland; Portland south

For areas served by Maine Public Service contact Nancy Chandler at 207-760-2556 for the interactive Hazard Hamlet presentation. The target audience is preschool to fifth-grade students. The presentation provides information on the do's and don'ts of electrical safety. Students have the opportunity to see the power of electricity and learn about potential hazards associated with unsafe behavior around power lines and household circuitry. Areas covered: all of Aroostook County.

Online References and Resources

Dig Safe

http://www.digsafe.com/

(State laws require anyone who digs to notify utility companies before starting. Digging can be dangerous and costly without knowing where underground facilities are located.)

Electrical safety checklists

http://www.pueblo.gsa.gov/cic_text/housing/indoor-safety/checklist.htm

Electrical Safety in the Home Fact Sheet: UMaine Cooperative Extension

http://www.umext.maine.edu/onlinepubs/htmpubs/2350.htm

Electrical Safety Myths

http://www.cmpco.com/UsageAndSafety/electricalsafety/safetymyths.html

How Electricity Can Hurt You

http://www2.cmpco.com/safety_world/hurt/index.html

Maine Public Service Safety Tips

http://www.mainepublicservice.com/safety/safety-information.aspx

May is Electrical Safety Month

http://www.eei.org/newsroom/energynews/Pages/20090501.aspx

Online article from How Stuff Works: "How Circuit Breakers Work."

http://electronics.howstuffworks.com/circuit-breaker2.htm

Online article:
What is the Difference between a fuse and a circuit breaker?

http://www.wisegeek.com/what-is-the-difference-between-a-fuse-and-a-circuit-breaker.htm

Review one or more of the electrical safety websites listed below:

Alliant Energy Kids: Electrical Safety
http://www.alliantenergykids.com/PlayingItSafe/ElectricSafety/index.htm

Bangor Hydro
http://www.bhe.com/kidscorner/kidscorner.html

Electrical Safety World (Multiple links to CMP resources, including a Teacher's Guide.and Is Your Home Safe: Electrical Safety Checklist

- Home Page: www.cmpco.com/safety
- Safety Checklist: http://www2.cmpco.com/safety_world/home_safe/index.html

Frankenstein's Lighting Laboratory: with links to Electrical Safety, Static Electricity, and Fruity Electricity
http://www.miamisci.org/af/sln/frankenstein/index.html

Maine Farm Safety Program: Bulletin #2350
University of Maine Cooperative Extension
http://www.umext.maine.edu/onlinepubs/htmpubs/2350.htm

Switched on Kids: Electricity and How to Use it Safely
www.switchedonkids.org.uk
(Select #2: Electrical Safety in Your House)