Stay Safe Around Electricity

Teacher's Guide

INTRODUCTION

The *Stay Safe Around Electricity* student activity booklet can be used as a follow-up to an electric utility's hazard board presentation or as a standalone piece to teach electrical safety concepts. This guide provides background for teachers on the electrical safety concepts contained in the booklet. It also includes ideas for further discussion and exploration.

AIM

To teach students the basic rules of electrical safety and the principles behind them.

OBJECTIVES

Students will be able to:

- Describe how electricity is generated, distributed, and used.
- Explain why electricity can be dangerous.
- Predict what is likely to happen in common situations involving potential electrical contact.
- Identify safe behaviors in each situation.

FOUR SIMPLE PRINCIPLES ABOUT ELECTRICAL SAFETY

Use these principles to help students understand the dangers represented in the activity book:

Electricity flows easily through *conductors*, like metal and water. It does not flow easily through *insulators*, like special rubber or glass

Water is an excellent conductor of electricity. Because the human body is mostly water, we are also good conductors of electricity.

Electricity always takes the easiest path to the ground.

If you come between electricity and the ground, you become a conductor for electricity and can be shocked. An electrical shock can seriously injure you.

PRODUCTION, DISTRIBUTION, AND USE OF ELECTRICITY

Pages 2 and 3 discuss how electricity is used, where it comes from, and how it gets to us.

Teacher Background:

Electricity is made at a power plant. Power plants use some form of fuel (coal, oil, natural gas, nuclear, hydro, wind, or solar) to heat water into steam, which turns the blades of a turbine. The turbine spins a generator, producing electricity.

Electricity travels through a grid of wires, including transmission lines (which carry high-voltage electricity over long distances) and distribution lines (which carry lower voltage electricity for use in homes and businesses). Distribution lines run overhead or underground.

Transformers, which change electricity's voltage, are found either on power poles or in large metal boxes on the ground. From distribution lines, electricity enters buildings and flows through wires in the wall that lead to lights and electrical outlets.

Discussion/Activities
Electricity is so much a part of our lives that we take it for granted. Ask students to imagine a day without electricity. What would they use for cooking, lighting, staying warm (or cool)?
Find out from your local electric utility whether they have any tours or resource materials on electricity and electrical safety.

HOW ELECTRICITY CAN HURT YOU
Page 4 explains how electricity can be harmful.

Teacher Background:
Electricity, by its nature, seeks the easiest path to the ground. It will travel there through any conductive material available. Human beings conduct electricity because we are 70% water, and water is a great conductor. If a person gets between electricity and the ground or something touching the ground, electricity will flow through him/her. A person standing on a tree, a ladder, or the floor is connected to the ground and can still be shocked.

Emphasize to students that an electrical shock can be quite serious. It can lead to serious internal and external burns. It can stop a person's heart. And it hurts.

Discussion/Activities
What is the difference between a bird sitting on a power line and you touching a power line? (The bird is not touching the ground or anything that is in contact with the ground, so electricity does not flow through it and it is not harmed.)
Have students make signs listing all the ways they know to behave safely around electricity. Ask students to take their signs home to help their families.

CONDUCTORS AND INSULATORS
Page 5 explains conductors and insulators. Potentially dangerous situations involving common electrical conductors (water and metal) appear on pages 8, 9, 13, and 14.

Teacher Background:
Conductors, like metal and water, allow electricity to flow through them. Water is such a good conductor that most insulators will not work if they are wet. The human body is 70% water, making us excellent conductors for electricity. Insulators, like special rubber or glass, resist the flow of electricity.

Discussion/Activities
Ask students to name a few common conductors. (Wires, cords, metal pipes, water, anything wet, paper clips, fingers or any part of the human body.)
Ask students to name a few common insulators. (Glass, air, dry dirt, special ceramics, rubber, and plastics.)
Make sure students understand the difference between insulating safety gear such as rubber boots, and household products such as athletic shoes and latex gloves, which do not protect against shock.

Remind students that they should never experiment with these household products and electricity.

POWER LINE SAFETY
Pages 4, 8, 9, 10, 11, and 12 relate to safety around overhead and underground power lines.

Teacher Background:
Most overhead power lines are not insulated, and thus are located high off the ground to prevent accidental contact. The rubber coating on some overhead power lines should not be confused with insulation; it is there to protect the power line from the effects of the weather, and is not meant to protect people from shock. Even if a line is insulated, the tiniest pinhole or break in the insulation puts you at risk.

Discussion/Activities
Why does electricity stay in overhead lines instead of flowing down the pole? (The wires are held away from contact with the pole by insulators made of special glass, ceramic, or plastic.)
Ask students to brainstorm how electric lineworkers are able to touch power lines safely. Remind them about insulators and how they might be useful in this situation. (Sometimes workers turn off the electricity in the power line before working on it. When they work on live lines, they use insulated tools, wear special insulating work boots with rubber soles [not athletic shoes], and use insulating gloves.) Emphasize that these workers take special measures that students should never try toduplicate. Invite your local electric utility to send someone to your classroom to demonstrate how lineworkers use safety equipment when they work on electric lines.
Remind students that if they are in a vehicle that contacts a downed power line (see p. 11), they are safe from electrical shock as long as they stay in the vehicle, and should wait there until help arrives. If they absolutely must leave the vehicle due to fire, ask students what they would do and why. (Jump clear, being careful not to touch the vehicle and the ground at the same time, so your body doesn't create a path for electricity to flow from the vehicle to the ground.)

ELECTRICAL EQUIPMENT
Pages 6 and 7 describe electrical equipment and how to stay safe around it.

Teacher Background:
Substations, pole-mounted transformers, and pad-mounted transformers may attract students' curiosity. Substation fences may look fun to climb, but the danger of shock is high. Pad-mounted transformer boxes contain equipment that can cause electrocution. The boxes are usually locked; students should stay away from them and report any damaged or unlocked boxes to an adult. Pole-mounted transformers do not pose as great a threat as pad-mounted transformers because they are much less accessible. However, the risk of shock is the same.

Discussion/Activities
Take students outside the school building and locate lines, transformers, and the entrance of electrical lines into buildings. What other equipment can they see? *(Possibly the electric meter.)* What is it used for? *(To measure how much electricity is used in the building.)*
Ask students to draw a map of their route to school, showing the places where they see electrical equipment. Include overhead lines, transformers, and substations.

HOME APPLIANCE SAFETY
Pages 13 and 14 show situations involving home appliances.

Teacher Background:
Home appliances are potentially dangerous because they are accessible to young children, their cords can become worn without being noticed, and the inside parts can malfunction without showing something is wrong. Appliances are commonly used around water, which increases the risk of shock.

Discussion/Activities
Explore with students their experience with electricity's dangers at home. Has anyone in the class been shocked, burned, or injured from an electrical appliance or other home use of electricity? Does anyone know someone who has? What happened? How did it happen? What thoughts did the person have afterwards? Did the experience have any effect on the safety measures these people take around electricity?

Ask students to look around the classroom or their homes for special electrical outlets called GFCIs (Ground Fault Circuit Interrupters), which are designed to quickly shut off power to prevent serious shock. What conclusions can they draw about where GFCIs are placed? (GFCIs are used outdoors and inside near water because those are the areas of greatest risk of electrical shock.) Have students ever seen GFCIs embedded in appliance cords? Why are they placed there? (To do the same thing as a GFCI in the wall.)

WHAT TO DO IN AN ELECTRICAL EMERGENCY
Page 15 explains what to do in case of electrical fire or shock.

Teacher Background:
Electrical fires are different than other fires because they have a source of electricity that is still conducting electric current. This is why you should never use water on an electrical fire. Putting water on an electrical fire gives electricity a way to travel to the rescuer, through the stream of water. Instead of water, an adult should use a multipurpose fire extinguisher (designed for electrical fires, wood/paper fires, and flammable liquids).

In case of electrical shock, never touch the victim! Students may think that if a person is already shocked or burned, the danger is over. But if the source of electricity is still live and near or touching the victim, the situation could be deadly for someone who approaches too closely. Instead, an adult should unplug the source of electricity (if it is safe to do so) or turn off power at the main switch.

Discussion/Activities
Ask students to explain why we don't use water on electrical fires. (The electricity could travel through the water and shock you.)
Ask students to describe the dangers to the rescuer in an electrical emergency. (If a would-be rescuer were to touch a person still in contact with the source of electricity that shocked him/her, the electricity flowing through the injured person would flow through the rescuer, too. The rescuer would become another victim.)