Stay Safe Around Electricity and Natural Gas
Teacher's Guide

INTRODUCTION
The *Stay Safe Around Electricity and Natural Gas* activity booklet can be used as a follow-up to a utility presentation or as a stand-alone piece to teach electrical and natural gas safety concepts. This guide provides background for teachers on the electrical and natural gas safety concepts contained in the booklet. It also includes ideas for further discussion and exploration.

OBJECTIVE
To teach students the basic rules and principles of electrical and natural gas safety. 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 and identify safe behaviors in each situation.
- Describe where natural gas comes from, and how it is distributed and used.
- Explain why natural gas can be dangerous.
- Identify unsafe and safe behaviors around natural gas, and know how to recognize a natural gas leak and what to do if one is detected.

KEY PRINCIPLES OF ELECTRICAL AND NATURAL GAS SAFETY
Use these principles to help students understand the dangers represented in the activity book:

1. Electricity flows easily through ***conductors***, like metal and water. It does not flow easily through ***insulators***, like special rubber or glass.
2. Water is an excellent conductor of electricity. Because the human body is mostly water, people are also good conductors of electricity, which is why it is dangerous to us.
3. Electricity always takes the easiest path to the ground.
4. 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.
5. Natural gas is pumped through underground pipes to our homes and businesses.
6. Natural gas is combustible, and we use it by burning it.

PRODUCTION, DISTRIBUTION, AND USE OF ELECTRICITY AND NATURAL GAS
Pages 2-4

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 magnets inside 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 change electricity's voltage and are found in substations, on power poles, or in large metal boxes on the ground, called pad-mounted transformers. From

distribution lines, electricity enters buildings and flows through wires in the walls that lead to lights and electrical outlets.

Natural gas is a colorless, odorless gas that is lighter than air. It is primarily methane gas that forms when organic material (plants and animals) decomposes under pressure. Methane gas that formed when ancient organisms decomposed was trapped under layers of solid rock and is found in the same underground areas where crude oil (petroleum) is found.

Wells are drilled through the rock to bring natural gas to the earth's surface. Then the gas is pumped to a processing plant where it is cleaned and then pumped through pipelines to towns.

A chemical called mercaptan is added to natural gas to make it smell like rotten eggs. We use natural gas in appliances, such as clothes dryers, stoves and ovens, furnaces, air conditioners, water heaters, outdoor gas lights, pool or spa heaters, barbecue grills, and fireplace logs, and in motor vehicles.

Discussion/Activities

1. Electricity and natural gas are so much a part of our lives that we take them for granted. Ask students to imagine a day without electricity and natural gas. What would they use for cooking, lighting, staying warm (or cool)?
2. Find out from your local utility whether they have any tours or resource materials on electricity and natural gas and on electrical and natural gas safety.
3. Natural gas is a fuel made by nature. How does it get buried under the earth? *(Explain how natural gas is formed.)*

HOW ELECTRICITY CAN HURT YOU
Page 5

Teacher Background
Electricity seeks the easiest path to the ground, traveling 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 kill him or her. And it hurts.

Discussion/Activities

1. 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.)*
2. Have students make signs listing all the ways they know to behave safely around electricity. Ask students to take their signs home to review with their families.

CONDUCTORS AND INSULATORS
Pages 6, 8, 9, and 12

Teacher Background
Conductors, such as 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. Insulators, such as special rubber or glass, resist the flow of electricity.

Discussion/Activities

1. 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.)*
2. 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.
3. Reiterate to students that water should never be squirted at a power line. The stream of water can conduct electricity and shock the person doing this.

Activity/Experiment

If you have a battery/wire/bulb circuit setup, use it to test a variety of materials to see how these allow or block the flow of electricity (e.g., conductors: penny, metal paper clip, metal barrette; insulators: eraser, rubber band, glass button). Have students predict which objects will conduct and which will insulate against electricity. Attach one of the wires from the battery to one end of the material being tested, and one of the wires from the light bulb to the other end of the material being tested. Have students observe whether or not the bulb lights up, and see if their predictions were correct.

POWER LINE SAFETY

Pages 5, 8-11, 13

(Page 13 also refers to safety around underground natural gas pipes.)

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. Stress to students that they should never touch power lines.

Discussion/Activities

1. Why does electricity stay in overhead lines instead of flowing down the pole? *(Insulators made of special glass, ceramic, or plastic are between the wire and the pole.)*
2. Ask students to brainstorm how electric line workers can 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 to duplicate.
3. 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. *(If they touch the car and the ground at the same time, they will be shocked. Instead, they should jump clear, land with feet together, and shuffle away with small steps, keeping their feet close together and on the ground.)*
4. Ask students what could happen if you start a digging project without first calling the utility locator service, accessible by dialing 811. *(You could strike an underground gas pipeline and cause a fire or explosion. You could strike an underground power line and get a shock.)*

ELECTRICAL EQUIPMENT
Page 7

Teacher Background
Substations, pole-mounted transformers, and pad-mounted transformers may attract students' curiosity. Substations and transformers contain equipment that can cause electrocution. Students should stay away from them and report any damaged or unlocked equipment to an adult.

Discussion/Activities
1. 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.)*
2. 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 12, 14 and 16

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. One should never play near gas appliances like a dryer or water heater.

Discussion/Activities
1. 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 or natural gas? Does anyone know someone who has? What happened? How did it happen? What thoughts did the person have afterward? Did the experience have any effect on the safety measures these people take around their appliances?
2. 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. Where are GFCIs placed? *(GFCIs are used outdoors and inside near water because those are the areas of greatest risk of electrical shock.)*
3. Ask students to suggest other items to add to the safety inspection on the back cover.

HOW TO BE SAFE AROUND NATURAL GAS
Pages 14 and 15

Teacher Background
Natural gas is a safe fuel when used properly. We use natural gas by burning it. To burn, natural gas must mix with the proper amount of oxygen and be ignited by a flame or spark. Burning natural gas without the proper amount of oxygen produces carbon monoxide, a deadly poison. When natural gas leaks, there is a risk of fire and explosion, and there is danger of fire if combustibles are stored or used too near gas appliances.

Discussion/Activities
1. What does natural gas smell like? *(Natural gas is odorless, but a chemical called mercaptan is added to make it smell like rotten eggs.)* Why do we want natural gas to smell bad? *(So we know when it's leaking and can protect ourselves.)*

2. What are some other signs of an outdoor gas pipeline leak? *(A hissing, whistling, or roaring sound, dirt spraying or blowing into the air, continuous bubbling in water, grass or plants that are dead or dying for no apparent reason.)*
3. Why should you tell an adult when you smell gas? Why leave the house if no adult is home? *(There is danger of fire or explosion from leaking gas. You could be seriously hurt.)*
4. Why shouldn't you use a light switch, candle, flashlight, TV, radio, garage door opener, or even a phone if you smell gas? *(Any of these things could cause a spark or flame that could ignite the gas.)*
5. What should you do if you suspect an outdoor gas pipeline leak? *(Do not use electricity or fire. Get far away from the area immediately and don't go back until safety officials say it's safe. Ask a trusted adult to report the leak to 911 and the local gas utility.)*
6. What should you do before starting a digging project? *(Call the underground utility locator service [at 811] to have them mark where underground lines and pipes are so you can dig safely.)*