Don't Get Zapped! Electricity and Natural Gas
Teacher's Guide

Introduction
Don't Get Zapped! gives your students potentially life-saving information about electrical and natural gas safety. Activities and readings go beyond warnings to help students understand how electricity works, and why it can be dangerous. Each page is a self-contained teaching unit and may be taught in sequence with the other pages, or independently.

This presentation guide provides answers to questions and puzzles in the booklet, as well as extension and discussion tips for each page.

Page 2: Table of Contents and Cliff Meidl Letter (Overview)
Objective: To give students an overview of booklet contents. And to make students aware that electrical injuries and fatalities do happen to kids, and can happen to them.

Note: After this booklet went to press, Cliff Meidl was selected by the U.S. Olympic Team to carry the nation's flag as the athletes entered the Olympic Stadium in Sydney, Australia, in 2000. He and his partner finished out of the medals in the two-man kayak event.

Page 3: Keeping the Beat (Biomedical Science)
Objective: For students to understand that electricity plays a role in our heartbeat, and that while electricity can be dangerous to contact, it also has many beneficial uses.

Answers: *Think About It!*
Students should have little trouble coming up with obvious ways we are helped by electricity (*lights, TV, appliances, calculators, etc.*). Offer extra credit to the most imaginative.

Pages 4 & 5: Olympic Competitor's Shocking Story (Power Line and Equipment Safety)
Objective: To make students aware of the dangers of contacting underground electric and gas lines and the need to call the underground locator service before digging to mark buried utilities. Students in this age group may do odd jobs around the house that could involve overhead and underground power line contact, so it's important to stress taking personal responsibility for avoiding power lines and other electrical equipment.

Answers: *Think About It!*
Cliff or his boss should have called the underground locator service to find the location of buried electric lines before starting work.

Answers: *What Do You Know About Power Line Safety?*
1. Transmission lines are a danger if people climb the towers, fly a kite into them, or if storms knock power lines loose. Don't climb on or play near these towers.
2. Substations house high-voltage transformers and other equipment. If a person touches this equipment, he or she could be killed. Keep out of substations.

3. Distribution lines carry high voltage. People can be hurt when they climb poles and touch the wires, climb a tree that is next to power lines, fly a kite into power lines, touch the wires with ladders or long tools, or touch fallen wires. Keep away from all power lines, always.
4. Service drops deliver electricity from power lines to buildings. These can be as high as 220 volts, and can be dangerous if touched or contacted with ladders or other equipment. Stay away from service drops.
5. Pad-mounted transformers are enclosed in steel boxes. People may be hurt or killed if they touch the equipment inside. Don't climb or play on pad-mounted transformers.
6. Underground lines are buried in the soil or in concrete, as Cliff Meidl found. People digging sometimes hit these lines with a jackhammer, shovel, or heavy equipment. Call your local electric utility or utility locator service before you dig to find out the location of buried lines.

Page 6: Experiment with Conductors and Insulators (Student Investigation)
Objective: For students to discover that some objects are conductors and others are insulators, and to learn the properties of each.

Experiment Tips: Teachers should strip the wires ahead of time and make sure the batteries are fresh. Though the illustration does not show it, use tape to stick the wires to the ends of the battery. Students are likely to know that metals are good conductors, but they may be unaware that things with a lot of liquid in them also conduct well. Some things to have on hand include lemons, pickles, and potatoes. When testing these, make sure students stick wires into the wet part of the item.

The key in the conduction of electricity is the movement of electrons. Metals are elements that freely share electrons. In liquids, dissolved ions can carry a charge as well. That is why water helps in the conduction of electricity. Salty water, loaded with sodium and chloride ions, helps even more. Lemons and pickles are likewise rich in dissolved ions.

Page 7: Fossil Fuel (Formation and Distribution of Natural Gas)
Objective: For students to learn about how natural gas was formed, and how it is brought to the earth's surface and delivered for usage. This page also teaches students how to recognize a gas pipeline leak, and what to do if they smell one. Emphasis should be placed on the various signs of detecting a gas leak, and how to respond. Refer to the bulleted lists on this page.

Answers: **Experiment with Gas**
Both natural gas and the gas formed in the experiment come from the decomposition of dead plants and other organic matter. Both natural gas and the gas formed in the experiment must develop in a nonporous, confined area or they will disperse. In both situations, there must be enough heat and an appropriate amount of decaying plants for a measurable amount of gas to form.

Pages 8 & 9: Electric Fish Tales (Electricity in Nature)
Objective: For students to understand that water is a good conductor of electricity, especially if it contains dissolved ions such as salt. Emphasize that students should never use high-power water squirters near power lines, as the water can conduct electricity from the lines right to them!

Answer: *Think About It!*
600 volts (eel) divided by 9 volts (battery) equals 66.7 batteries to equal the shock from one electric eel.

Experiment Tips:
See the tips for the page 6 experiment. The key to conduction through liquids is the presence of dissolved ions. Salt is one of many sources of ions.

Pages 10 & 11: Lighting Treasure Hunts (Guarding Against Shock)
Objective: For students to understand how we protect ourselves from shock by the use of ground fault circuit interrupters (GFCIs).

Answers: *Think About It!*
A GFCI would activate for divers if there were a short circuit in the equipment, or if the insulation of wires or equipment were damaged and allowed electricity to leave the circuit. It could activate in a bathroom or kitchen for the same reasons. (Students may think of specific examples, such as a hairdryer or radio falling into the bathtub.)

Answers: *Just a Little Current Can Kill You*

1. 1 amp = 1000 milliamps
2. Contact with 1 amp would probably be fatal
3. 5 milliamps is the level at which a shock begins to become dangerous

Page 12: Is Your Home Safe?/Overload Alert! (Home Inspection)
Objective: To get students to take responsibility for checking the safety of their electrical outlets, cords, and appliances at home. Students will also learn the need to properly maintain gas appliances and equipment, and to practice safe behaviors around them.

Answers: *Watts/Amps Table*

Divide the wattage for each appliance by 120 to get the amps.
Answers to Questions:
You could run the color TV, the coffee maker, and the microwave oven at the same time.
The iron and the portable heater would overload the circuit.

Answer: *Think About It!*
If someone overloaded a circuit, it is likely that a fuse blew or a circuit breaker tripped, causing the electricity to go off.

Page 13: Find the Hidden Hazards (Review of Outdoor Electrical Safety)
Objective: For students to identify hazards and explain how to prevent them.
The nine hazards are:

1. Someone climbing the substation fence.
2. A fallen wire from the utility pole on the sidewalk.
3. A child flying a kite near power lines.
4. A sprinkler near an electric lawn mower.
5. A boom box being used near water.
6. A ladder about to hit a service drop.
7. A fallen power line on top of a crashed car.
8. A child climbing a tree near power lines.

Encourage students to answer the questions at the bottom of the page with a partner or in a small group. Students' answers will vary, but in all cases should include an action the person can take to make the situation safe. (*Note*: The people trapped in the car with a power line on it should stay in the car and warn others away. Anyone who touches the car and the ground at the same time will be seriously hurt or killed. If students are ever in a car that contacts a power line and they need to get out of the car because of fire or other danger, they should do the following: jump clear without touching the car and ground at the same time, and shuffle away, taking small steps and keeping feet close to each other.)

Pages 14 & 15: Lightning and Storm Safety (Danger from Lightning)
Objective: For students to understand that high-voltage shock can come from lightning as well as wires, and to learn the many precautions they can take to avoid a lightning strike.

Answer: *Think About It!*
The electricity in both lightning and power lines is very high voltage. It can travel through a person's body on its way to the ground.

Page 16: What Do You Know About Electric & Natural Gas Safety? (Crossword)
Across
1. insulator
2. easiest
3. call
4. electron
5. burn
6. volts
7. power
8. watts
9. smell

Down
10. ground
11. circuit
12. defibrillator
13. leave
14. geologists
15. transformers
16. outlet