Zap! Play It Safe Around Electricity, Water & Natural Gas

Teacher's Guide

Introduction
Zap! gives your students potentially life-saving information about electricity and natural gas, water sports safety, and disaster preparedness. Activities go beyond warnings to help students understand how electricity and natural gas work in our lives, and why they 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.

Page 2: Table of Contents (Overview)
Objective: To give students an overview of booklet contents.

Extension: Ask students to select the story that is most interesting to them and to read that one first. Invite them to write their own articles about electrical, water or natural gas safety. The article may focus on a dangerous experience someone has had, and/or how to be safe around electricity or natural gas, or when engaging in water sports.

Page 3: Keep 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 to "Think About It!"
Students should have little trouble coming up with obvious ways in which they are helped by electricity (lights, TV, appliances, calculators, and so on). Consider having students work in pairs or small groups.

Page 4: Go with the Flow (Hydropower)
Objective: For students to understand the hydrologic cycle, how the water flowing through this cycle can be harnessed as hydropower to create energy, and how to stay safe in and near hydropower facilities like reservoirs.

Water Cycle Background/Discussion: The water cycle is a continuous natural system that keeps water always in motion. Explain that every molecule of water that was present when the earth was formed is still present today. The same water has moved from the oceans to the atmosphere, dropped down to the land, and eventually moved back to a body of water. *Evaporation* occurs when the sun heats up water in rivers, lakes, or oceans and turns it into vapor or steam, which then rises up into the air. *Condensation* happens when the water vapor in the air gets cold and changes back into liquid, forming clouds. *Precipitation* occurs when so much water has condensed that the air cannot hold it anymore. The clouds get heavy and drop water back to the earth in the form of rain, hail, sleet, or snow. Once back on the land, water will either soak into the earth or run over the soil as *runoff*. The sun's energy, in combination with the force of gravity, keeps the water moving without end.

Extension: Ask students to design their own water cycle diagram, drawing and labeling the main concepts: evaporation, condensation, precipitation, and runoff.

Hydropower Discussion: Ask students if they have ever gone swimming, boating or camping near a hydropower reservoir. Ask them if they had known about the dangers of recreating near these, and what types of precautions they or their family members took to stay safe.

Invite students to create a poster with important safety tips for play in and around water—whether a reservoir or any other body or water. If possible, invite a younger class in to the classroom to view the posters when they're finished, so older students can help educate younger students about water safety.

Page 5: Is Your Family Prepared? (Flood Preparedness)
Objective: To help students and their families prepare for flooding and severe storms.

Encourage students to share the tips about emergency kits, family evacuation planning, and flood warning signs with parents/guardians and siblings.

Think About It: Most of California's hydropower reservoirs are located in the high mountains for two reasons: because higher areas get more rain/snowfall, and so the water can flow downhill with the force of gravity to turn turbines that generate electricity.

Pages 6 & 7: Electrical Safety at the Circus (Power Line and Equipment Safety)
Objective: For students to understand that electricity travels in wires, that these wires are covered with insulation for protection, and that it's important to stay away from power lines and other electrical equipment.

Answers to "Think About It!"
In your neighborhood, overhead and underground power lines carry electricity from where it is produced (power plant) to where it is used. At the circus, power lines carry electricity from a generator to where it is used.
In your neighborhood, overhead power lines are not insulated but at the circus they are insulated. And unlike in your neighborhood, at the circus specially insulated cables are sometimes laid right on the ground.

Answers to "What Do You Know About Power Line Safety?"

1. Transmission lines can be dangerous if people climb the towers or 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 climbs over the fence and touches this equipment, he or she could be killed. Keep out of substations.
3. 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 equipment. Stay away from service drops.
4. 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. If you see one open, call your electric utility.

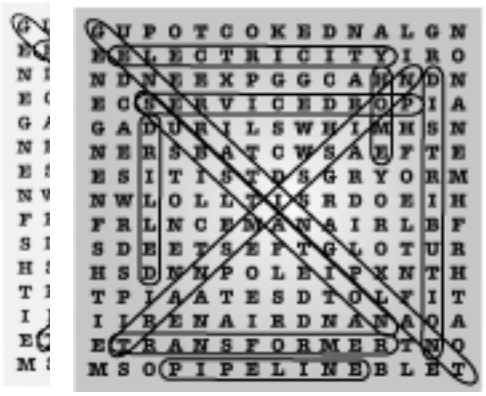
Page 8: Say What?! (Fascinating Facts)
Objective: To help pique students' interest in the discovery and workings of electricity and natural gas, and to stress the importance of safety around buried gas pipelines.

Extension/Discussion: Discuss with students the dangers of contacting underground gas and other utility lines when doing digging projects around their homes. An adult should call the underground locator service, now accessible by dialing 811, several days before digging so buried utilities can be located and marked.

Ask students to come up with their own fascinating facts about electricity or natural gas. Sources might include encyclopedias, the Internet, or the library. Students can share their facts in small discussion groups or with the entire class.

Page 9: Really Cool Fossil Fuel (Formation and Distribution of Natural Gas)
Objective: For students to learn about how and when natural gas was formed, and how it is brought to the earth's surface and delivered for usage. This page teaches students how to recognize a gas pipeline leak: a smell of sulfur or rotten eggs; a hissing or roaring sound; dirt spraying or blowing into the air; continual bubbling in water; grass or plants dead or dying for no apparent reason. It also teaches them how to respond to a gas leak: don't use any fire or electricity as these could create a spark and ignite the gas; go far away from the area and do NOT return until safety officials say it is safe; get a trusted adult to call 911 and the utility company. Please reiterate these important pipeline safety tips! Also make sure students know that if they smell a gas leak inside their home they should avoid using a light switch, candle, flashlight, TV, radio, garage door opener, or phone; they should get everyone out of the house and go to a safe location; and they should have an adult report the leak to 911 and the local natural gas utility.

Word Search Solution:



Pages 10 & 11: 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.

Answer to "Think About It!"
600 volts (eel) divided by 2 volts (battery) equals 300 batteries.

Will the Bulb Light?
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. Help students form a hypothesis that addresses whether the bulb will light and what will happen when salt is added to the water. The key in the conduction of electricity is the movement of 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. Encourage students to share and discuss the results of this experiment in groups or as a whole class.

Pages 12 & 13: 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 to "Think About It!"
Ways in which treasure hunters protect themselves from shock include the following: a GFCI at the generator, heavy-duty insulation around the cables that carry electricity to divers' equipment, special cases filled with

compressed gas to insulate dive lights, and special rubber gloves that divers wear when handling electrical equipment.

Answers to "Just a Little Current Can Kill You"

1. They would feel a small shock.
2. They would probably die.
3. 5 milliamps is the level at which a shock begins to be dangerous.

Page 14: Is Your Home Safe? (Home Inspection)
Objective: To get students to take responsibility for checking the safety of their electrical outlets, cords, and gas and electric appliances at home.

Home Safety Inspection: Ask students to take this inspection checklist home and to do the inspection with their families. Ask students to report what hazards, if any, they found in their homes, and whether/how their family fixed the hazard.

Discussion: Ask students if they have ever seen an outlet as badly overloaded as the one in the photograph. Ask if they have ever seen books or magazines stored near a natural gas furnace or water heater. Discuss what could be done to fix each of these situations. Ask students if they have ever seen someone climbing or playing in a tree near a power line. Discuss and role-play ways students can intervene when they see family members or friends engaging in unsafe activities around electricity and natural gas.

Page 15: Find the Hidden Hazards (Review of Outdoor Electrical and Natural Gas 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.
9. Children digging and about to contact a buried gas pipeline.

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 their feet close together.)

Page 16: Stay Safe Around Trees and Power Lines (Safe Tree Planting)
Objective: To inform students of the potential hazards of trees near power lines, and of safe procedures for planting trees with respect to overhead and underground power lines.

Encourage students to share the "Plant a SafeTree" section with their families.

Discussion: Ask students to name some types of outdoor activities that are unsafe to pursue around power lines. (Possible answers include: shooting high-power water guns; having metallic balloons outside, where they could get tangled in power lines; flying kites; climbing trees with power lines near the branches.)