



# The Shocking Truth About Electrical & Natural Gas Safety

## Teacher's Guide

### KEY CONCEPTS ABOUT ELECTRICITY AND ELECTRICAL SAFETY

1. Electricity is a form of energy that results from the flow of electrons moving from atom to atom.
2. Electricity travels in a closed loop called a circuit.
3. Electricity flows easily through conductors, not through insulators.
4. Electricity always takes the easiest path to the ground.
5. Water is an excellent conductor of electricity. Because the human body is mostly water, we are also good conductors of electricity.

### KEY CONCEPTS ABOUT NATURAL GAS SAFETY

1. Natural gas is a safe fuel when used properly.
2. Natural gas is pumped through underground pipes to our homes and businesses.
3. We use natural gas by burning it.
4. Leaking natural gas can be ignited by a spark from almost any appliance, even a flashlight or phone, causing a fire or explosion.
5. If a gas leak is suspected, people should remove themselves from the area and report the leak.

### LEARNING STRATEGIES

Students read information and do activities individually, work with partners or in small groups, and discuss information, ideas, and/or answers as a class.

### QUESTIONS FOR REVIEW & ASSESSMENT

- Describe the path electricity travels in these pictures. Pgs. 2, 4 (*Electricity will either travel in a closed circuit or find its way to the ground through a person or another conductor that comes between electricity and the ground. Students should be able to identify the points of contact and the path electricity would take.*)
- Which materials are insulators? Which ones are conductors? Pgs. 3, 9
- What happens if you get between electricity and the ground? Pgs. 4-8, 10 (*In all likelihood, you will be injured or killed.*)
- Why is there danger of electrical shock in the situations portrayed? Pgs. 4-6, 8, 9, 10 (*Because a person either has come into contact with or could possibly contact electricity, giving it a path to the ground.*)
- Why are we at risk of electrical shock when we contact electricity? (*Because we are good conductors, and we are almost always touching the ground.*)
- What could happen if you squirt water at a power line? Pg. 6 (*Electricity can travel down the stream of water and shock you.*)
- Describe safe alternatives to the situations shown/discussed. Pgs. 4-6, 8, 9 (*Student answers will vary and may include both general and specific safety "rules" such as: keep water and electricity apart; fly kites far away from power lines; be sure the insulation around the power cord to an appliance isn't frayed or broken.*)
- What precautions should you take to avoid becoming part of electricity's path to the ground? Pgs. 4-6, 8, 10-12

- List three steps to take in the event of an electrical fire or electrical emergency. Pg. 12  
*(In case of electrical fire: leave the area; telephone for help from a safe location or tell an adult; have an adult use a proper chemical fire extinguisher on the fire. In case of electrical emergency: tell an adult to pull the plug or turn off the power at the circuit breaker/fuse box; call for help; when you are CERTAIN all danger is gone, give first aid.)*
- What may be the hardest thing to remember in an electrical emergency? Pgs. 10-12  
*(That you must stay away from the victim until you are certain you will not be shocked also.)*
- Where does natural gas come from? Pg. 13  
*(Natural gas forms deep under the ground when plant and animal material decomposes over thousands of years and gives off methane gas.)*
- Why is it important not to play on or around natural gas appliances or pipes? Pg. 15  
*(Appliances use natural gas by burning it and may ignite other materials that are too close. If the oxygen supply is blocked, natural gas burns inefficiently and a poisonous gas called carbon monoxide can form. If appliances or pipes are damaged and gas leaks, there is danger of fire or explosion.)*
- What are some signs of a gas pipeline leak? Pg. 14  
*(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 that are dead or dying for no apparent reason)*
- What is the correct response if you suspect a gas pipeline leak? Pg. 14  
*(Do not use fire or electricity—not even a flashlight or phone. Go far away from the area immediately and do not go back until safety officials say it is safe. Ask a trusted adult to call 911 and the local natural gas utility.)*

## SUPPLEMENTARY APPROACHES

To bolster student understanding or to take them deeper into the information, here are a few other activities and approaches to learning.

### Main Concept, Pages 2-4

Electricity travels in a closed path called a circuit.

#### Supplementary Approaches, Page 2

Ask students to describe the path electricity travels to get to the lights in the classroom and back to the distribution grid.

#### Supplementary Approaches, Page 3

Water is such a good conductor that most insulators will not work if they are wet. Have students wet their best insulator from their experiment, observe what happens, and explain why it happened. Tell students that metal is another excellent conductor, which is why metallic Mylar balloons are unsafe outside. If Mylar balloons get caught in power lines or substations, they can cause fire or power outage because of their electricity-conducting capacity. For this reason, they should be kept inside and tied down to a heavy weight so as not to escape. If students ever spot one caught in a line, they should report it to the local electric utility immediately.

### Main Concept, Pages 4-11

Electricity always takes the easiest path to the ground. If you become part of that path, you will be injured.

#### Supplementary Approaches, Page 5

Ask students to think about ways not to touch the ground. Remind them about insulators and how they might be useful in this situation. *(Students might suggest wearing rubber-soled shoes [not athletic shoes] or some way to hold a layer of air between them and the ground. Point out that there aren't many ways to avoid becoming part of electricity's path to ground.)*

**Main Concept, Pages 4, 7, 10**

Electricity is measured in volts, watts, and amps.

**Supplementary Approaches, Page 4**

Help students understand the relationship of amps, watts, and volts, explain that electricity flowing through a wire is like water flowing through a garden hose. The amount of water depends on the diameter of the hose (amps). The pressure of the water depends on how far open the faucet is (volts). The amount of work that can be done (watts) depends on both volts and amps.

**Supplementary Approaches, Page 7**

Watts = volts  $\times$  amps. Assume you have a 1000 W hairdryer plugged into a 120 V circuit. How much amperage is available? ( $1000/120 = 8.33$  amps) What would happen if you accidentally came into contact with that much amperage? (*The contact would probably be fatal.*)

**Main Concept, Pages 6-7, 12**

Water is an excellent conductor of electricity. Because the human body is mostly water, we are also good conductors of electricity. This is one reason children should never squirt water at power lines.

**Supplementary Approaches, Pages 3, 6**

Water is such a good conductor that most insulators will not work if they are wet. Have students wet their best insulator from their experiment, observe what happens, and explain why it happened. Where should GFCIs be placed? Why? (*GFCIs are used outdoors and inside near water because those are the areas of greatest risk of electrical contact with water.*)

**Main Concept, Pages 8-10**

Identify kinds of electrical equipment, their dangers, and safe behavior.

**Supplementary Approaches, Page 8**

Take students outside the school building and locate lines, transformers, and where electrical lines enter buildings. If they don't see power lines, where are they? (*Underground*)

**Supplementary Approaches, Page 9**

Ask your local electric company to send someone to your school to demonstrate safety equipment used by line workers.

**Supplementary Approaches, Pages 10, 12**

Ask students to go home and discuss safe behaviors around downed power lines with their families. Ask students to plan an emergency escape route with their families to use in case of a fire. Ask them to draw a map of the route and discuss it in class with a small group. What features do different plans have in common?

**Main Concept, Page 11**

It's important to tell students that if they touch someone who is in contact with an electricity source, electricity will travel through them as well, and they could be seriously hurt or even killed.

**Main Concept, Page 13**

Natural gas is a form of energy buried under the earth. It is a safe fuel when used properly. To avoid puncturing an underground gas pipeline and causing a gas leak, anyone planning a digging project should call the underground utility locator service at 811 several days in advance. They will mark the location of buried utilities so people can dig a safe distance away.

Supplementary Approaches, Page 13

Approximately three million miles of steel pipeline brings natural gas to our homes and businesses across the United States. Tour your school to learn where natural gas is used. Ask students to identify where natural gas enters homes and businesses.

**Main Concept, Pages 14-15**

Know what to do if you smell gas, see downed power lines or an electrical fire, or encounter an electrical contact emergency. Know how to detect gas leaks, indoors and outdoors.

Supplementary Approaches, Page 14

Ask students to name the five signs of a natural gas leak. (*Leaking gas smells like sulfur or rotten eggs. Other outdoor gas leak warning signs are: a hissing, whistling, or roaring sound, dirt spraying or blowing into the air, continuous bubbling in water, or grass or plants that are dead or dying for no apparent reason.*) Reinforce with students that if they notice any of these signs, they should not use a candle or anything electrical—not even a flashlight or phone. They should go far away from the area right away, and should NOT go back until safety officials say it is safe. They should ask a trusted adult to report the leak by calling 911 and the local natural gas utility.

**Main Concept, Page 15**

The area around gas-burning equipment and appliances should be clean and litter free.

Supplementary Approaches, Page 15

Ask students to develop a gas safety inspection that lists gas appliances and has a checklist of problems to look for, such as obstructed ventilation, litter, smell of gas, or signs of corrosion on pipes. If students have natural gas at home, have them do the inspection with an adult.

**ANSWER KEY**

Note: Many of the activities in *The Shocking Truth About Electrical & Natural Gas Safety* don't have "answers" per se, but are activities designed for cooperative learning.

**Page 2:**

1. Students should place an "X" on the power plant.
2. The path should be traced from the power plant to the video game control.
3. The path should be from the video game control back to the power plant.

**Page 3:**

Point out to students that energy is transferred along the circuit's path by electric current.

1. The following materials are conductors: foil, paper clip, tin lid, penny.
2. The following materials are insulators: toothpick, dry dirt, glass, leather, plastic lid, paper, rubber band, eraser.
5. Answers will vary according to what items the students choose.

**Page 4:**

1. The path electricity travels is called a circuit.
2. The amount of electricity flowing through a conductor is measured in amps.
3. The pressure at which electricity flows is called voltage.
4. The place where electricity is always trying to go is the ground.

**Page 5:**

1. An electric source (a wire) and the ground.
2. The people shown could become electricity's easiest path to the ground by touching electricity and the ground (or something in contact with the ground, like the tree, the pole, the floor, or the ladder) at the same time. If they

do, they can be shocked or electrocuted. (Insulators between the wires and the pole prevent contact with the ground.)

3. In each case, electricity would travel from the source, through the person's body, and down to the ground.

4. No, because the bird isn't touching the ground. When the bird sits on the wire, it is not injured because it is not in contact with the pole or ground.

**Page 6:**

If you squirt water at a power line, electricity can travel down the stream of water and shock you. Cross out the picture of the girl washing the car near the electric weed trimmer, the boy washing dishes by the radio, and the girl drying her hair by the sink. These are all activities in which the person could get hurt by electricity because of the water nearby.

**Page 7:**

Your body is 60-70% water.

1. Because contact with any higher amount of milliamps could potentially be harmful to a person. So the current shuts off to prevent shock or electrocution.

2. 8000 milliamps

3. Probably fatal

**Page 8:**

The top left picture is F.

The top right picture is C.

The middle left picture is E.

The middle right picture is B.

The bottom left picture is A.

The bottom right picture is D.

**Page 9:**

The safety goggles would provide better protection for the eyes.

The insulated gloves on the left are thicker, provide better insulation, and won't tear easily.

The hard hat on the right would protect them from falling objects. Plastic is also a good insulator.

**Page 10:**

The metal around the car and in the tires conducts the electricity from the power line into the ground and keeps you safe—as long as you stay inside the car. If you touch the car and the ground at the same time, then electricity would have a path to the ground. If you touch the body of the car to help someone from the car, you provide a direct path for the electricity to go to the ground.

**Page 11:**

If you touch a person who is in contact with electricity, you will be shocked also.

**Page 12:**

If a person tried to put out an electrical fire with water, the water would give electricity a path to the person's body and electrocute them.

**Page 13:**

Point out to students that natural gas is a natural resource that helps fuel our homes and businesses.

1. Fireplace, 2. Clothes dryer, 3. Lights, 4. Water heater, 5. Furnace, 6. Air conditioner, 7. Range, 8. Barbecue

**Page 14:**

Puzzle answer: Get right outside quickly!

Going Further: These actions could ignite leaking gas with a spark or an open flame, causing a fire or explosion. Even the smallest spark from a phone, flashlight, or electrical switch could ignite the gas.

**Page 16: CROSSWORD PUZZLE**

Across Answers

- 2. Body
- 4. Electricity
- 8. Shock
- 9. Circuit
- 10. Fault
- 11. Open
- 14. Outlets
- 16. Voltage
- 17. Pipes

Down Answers

- 1. Conductors
- 3. Frayed
- 5. Candles
- 6. Insulators
- 7. Ground
- 10. Flame
- 12. Towers
- 13. Leave
- 15. Water