The Shocking Truth About Electrical and Natural Gas Safety
Teacher's Guide, Grades 4-6

KEY CONCEPTS ABOUT ELECTRICAL SAFETY

1. Electricity travels in a closed loop called a circuit.
2. Electricity flows easily through conductors, not through insulators.
3. Electricity always takes the easiest path to the ground.
4. 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, causing a fire or explosion.
5. Suspected gas leaks should be reported and people should remove themselves from the area.

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 this picture. Pgs. 2, 5-7 *(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. 4, 10
- What happens if you get between electricity and the ground? Pgs. 5-9, 13 *(In all likelihood, you will be injured or killed.)*
- Why is there danger of electrical shock in the situations portrayed? Pgs. 5-7, 9, 10, 13 *(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. 7 *(Electricity can travel down the stream of water and shock you.)*
- Describe safe alternatives to the situation shown/discussed. Pgs. 5-7, 9, 10 *(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. 5-7, 9, 13-15

- List three steps to take in the event of an electrical fire or electrical emergency. Pg. 14
  (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. 13-15
  (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. 3
  (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? Pgs. 11, 12
  (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. 12 (*A smell of rotten eggs, hissing sound, dirt being blown up into the air, continual bubbling in a pond, river, or creek, plants that seem to be dead or dying for no reason)*

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, 5
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.

Main Concept, Page 3
Natural gas 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 well in advance. They will mark the location of buried utilities so people can dig a safe distance away.

Supplementary Approaches, Page 3
Approximately one million miles of steel pipeline bring natural gas to our homes and businesses across the U.S. Tour your school to learn where natural gas is used. Ask students to identify where natural gas enters homes and businesses.

Main Concept, Pages 5-10, 13, 15
Electricity always takes the easiest path to the ground. If you become part of that path, you will be injured.

Supplementary Approaches, Page 7
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 7, 8, 14
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, Page 4 & 7
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 5, 8, 13
Electricity is measured in volts, watts, and amps

Supplementary Approaches, Page 5
To 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 8
Watts = volts x amps. Assume you have a 1,000 W hairdryer plugged into a 120 V circuit. How much amperage is available? *(1,000/120 = 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 9, 10, 13
Identifying kinds of electrical equipment, their dangers, and safe behavior.

Supplementary Approaches, Page 9
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 10
Ask your local electric company to send someone to your school to demonstrate safety equipment used by lineworkers.

Main Concept, Pages 11, 12
The area around gas-burning equipment and appliances should be clean and litter free.

Supplementary Approaches, Page 11
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.

Main Concept, Pages 12-15
What to do in an electrical fire, electrical emergency, or if you smell gas. How to detect gas leaks, indoors and outdoors.

Supplementary Approaches, Page 13
Ask students to go home and discuss safe behaviors around downed power lines or gas pipeline leaks with their families.

Supplementary Approaches, Pages 12, 14
Ask students to plan an emergency escape route with their families to use in case of fire or a gas leak. 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?

ANSWER KEY
Note: Many of the activities in *The Shocking Truth About Electrical and 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 control back to the power plant.

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

Page 4:
1. The following materials are conductors: water, foil (aluminum), paper clip (steel), can (tin).
2. The following materials are insulators: toothpick (wood), dry dirt, glass, hose (air), leather, plastic, paper, and rubber band.

Page 5:
The path electricity travels is called a circuit.
The amount of electricity flowing through a conductor is measured in amps.
The pressure at which electricity flows is called voltage.
The place where electricity is always trying to go is the ground.

Page 6:
1. An electric source (a wire) and the ground.
2. When one of these people or a bird touches 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, he or she becomes part of electricity's easiest path to the ground and 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. If a bird touches the pole (an extension of the ground) and a wire at the same time, it could be electrocuted.
4. No, because they aren't touching the ground. When the birds sit on the wire, they are not injured because they are not in contact with the pole or ground.

Page 7:
Circle only the top picture. Cross out the other three pictures.
If you squirt water at a power line, electricity can travel down the stream of water and shock you.

Page 8:
1. 1,000 milliamps
2. 10,000 milliamps
3. Probably fatal
Your body is 70% water.

Page 9:
The top left picture is F.
The top right picture is B.
The middle left picture is E.
The middle right picture is D.
The bottom left picture is C.
The bottom right picture is A.

Page 10:
The hard hat would protect them from falling objects. Plastic is also a good insulator.
The safety goggles would provide better protection for the eyes.
The insulated gloves on the right are thicker, provide better insulation, and won't tear easily.

Page 12:
"Get right outside quickly!"
Going Further: These actions could ignite the leaking gas with a spark or an open flame, causing a fire or explosion.

Page 13:
The car rests on four rubber tires that are insulators. The air and tires separate the metal car body from the ground. 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 to the ground. If you touch point A and point B at the same time, 2,500 volts would flow through the person's body.

Page 14:
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 15:
If you touch a person who is in contact with electricity, you will be shocked also.

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