Electrical Safety World
Teacher's Guide

Electrical Safety World uses information, experiments, games, and activities to teach students the principles and practices of electrical safety. The site is geared for a range of interests and reading levels and can be used by students in elementary and middle school. (Non-readers will be able to play the games with adult assistance.)

This Teacher's Guide contains three sections:

- Site overview.
- Questions and activities to review key safety principles.
- Experiments, guidance and set-up.

I. SITE OVERVIEW

The informational areas of the site explain the basic science of electricity and electrical safety principles with text, pictures, and experiments. The games simulate common indoor and outdoor electrical safety situations, giving students a chance to put safety principles into practice. The activities ask students to apply electrical safety know-how in their own lives.

Here's what each area contains:

- **The Travels of Electricity (INFORMATIONAL)**
  What electricity is, where it comes from, and how it travels. Covers the electric distribution system, conductors, and insulators. Contains experiments about circuits and conductors/insulators.

- **How Electricity Can Hurt You (INFORMATIONAL)**
  How electricity behaves and how it can hurt people. Covers grounding, electricity and water, appliance safety, and the effects of electric shock. Contains experiments about electricity and water, and short circuits.

- **In Case of Emergency! (INFORMATIONAL)**
  Teaches students how to respond to electrical fires, electric shock, downed power lines, power lines on a vehicle, and power outages.

- **Tree and Power Line Safety (INFORMATIONAL)**
  Explains the hazards of trees near power lines, and how students can climb, plant, and trim trees to avoid power line contact.

- **Find the Hidden Dangers (GAME)**
  A game to test students' understanding of how to play it safe around electricity

outdoors. Within busy street scenes, students must identify electrical hazards involving power lines and electrical equipment.

- **Make the Safe Choice (GAME)**
  A game to test students' awareness about electrical safety inside the home. The game presents electrical hazards that are relevant to students' lives and asks students to identify the safest response.

- **Shock Blocker (GAME)**
  Students play against the computer to prevent water from creating a path for electricity to flow from a power line, electrical outlet, or lightning bolt.

- **Tell Me More About Electricity (INFORMATIONAL)**
  This section is not safety-related but instead provides additional information for students interested in other aspects of electricity. Covers electricity basics, electricity generation, pioneers of electrical discovery, electric vehicles, and energy efficiency/conservation.

- **Home Safety Audit (ACTIVITY)**
  A checklist students can use with parents to inspect their home for electrical hazards.

- **Tell Your Story (ACTIVITY)**
  Profiles a real-life shock victim who is an Olympic kayaker. Asks students to interview someone who has had an electric shock, to tell their own electric shock story, or to report on one from a newspaper article. Focus is on sharing how the incident occurred and how it could have been prevented.

- **Safety Certificate**
  This is a checklist of site locations students can use to map their progress, plus an electrical safety pledge. We recommend students print the certificate before starting the site and have a parent or other adult sign it after they have visited the main areas.

- **Glossary**
  Definitions of electricity-related words found on the site. These definitions may be accessed by clicking on the words wherever they appear highlighted on the site (usually their first reference within a section.)

- **Links to Related Sites**
  Hot links to related sites about the science of electricity, electrical inventions, and electrical safety.

II. QUESTIONS AND ACTIVITIES

These questions and activities review the key safety principles from Electrical Safety World. Here are a few ideas for how to use them with your class:

- Use as discussion points for verbally reviewing basic electrical safety information with the whole group.
- Use as a pre- and post-test to assess student understanding of electrical safety principles before and after visiting Electrical Safety World. (To use as a written test for older students, cut and paste the questions into your word processing program, delete the answers, and print out one sheet for each student.)
- Put students into small groups and assign each group several questions; ask them to use the website to find the answers. (Answers to questions 1-12 can be found in The Travels of Electricity; questions 13-19 are based on How Electricity Can Hurt You.)
- After all students have completed all sections of the website, organize the class like a game show: "contestants" can continue to answer questions until they get one incorrect, at which point a new contestant takes their place.

<u>Electrical Safety Questions</u>

1. What is electricity a form of? (Energy.)

2. What does electricity travel on to get from the power plant to people's houses? (Overhead and underground power lines.)

3. What other equipment is involved in getting electricity to where it can be used by people? (Some or all of the following are correct: substations, pole-mounted and pad-mounted transformers, service drops, meter boxes, electrical wiring, appliance cords.)

4. How fast does electricity travel? (At the speed of light, 186,000 miles per second.)

5. Could you move faster than electricity? (No!)

6. List some good conductors of electricity. (Metal, water)

7. Is the human body a good conductor of electricity? Why/why not? (Yes, because it is mostly water.)

8. What will happen if electricity travels through you? (You will be shocked and could be badly hurt or even killed.)

9. List some good insulators. (Special rubber, glass.)

10. Why are insulators important? (They keep electricity from leaving wires.)

11. What would happen if a power line were to fall from the power pole to the ground? (It would energize the area around it with a lot of electricity and people touching the line or coming near it would be hurt or killed.)

12. If you overload an outlet by plugging in too many things, what can happen? (Cord insulation can overheat and melt, causing a shock and fire hazard.)

13. Why are people good conductors of electricity? (Our bodies are mostly water, and water conducts electricity.)

14. Do you have to be touching the ground directly to conduct electricity? (No, you could be touching something that is touching the ground, like a ladder.)

15. Why should you never touch anything electrical while you have wet hands or while standing in water? (Water conducts electricity and you could be shocked.)

16. What is the purpose of rubber or plastic insulation around appliance cords? (It keeps the electricity in the wires and prevents you from getting a shock.)

17. If a person is shocked, what can happen? (Muscle spasms, weakness, rapid pulse, severe burns, unconsciousness, or death.)

18. Why can birds sit on power lines without being shocked? (The birds do not touch the ground or anything in contact with the ground.)

19. Why could a kite caught in a power line be dangerous to try to retrieve? (If you touch the kite while you are in contact with the ground or anything touching the ground, like a ladder, electricity will travel from the power lines down the kite and into you, and you will be shocked.)

<u>Activities for Going Further</u>

- Prepare a one-minute presentation or play for your class on the basics of how electricity travels from the power plant to appliances in people's homes.

- Prepare a poster showing electricity going through a person on its way to the ground. The source of the electricity could be a power line or an appliance cord.

- Think of three ways you can convince your friends to be safe around electricity. Share them with the class.

- Create a radio commercial about outdoor or indoor electrical safety.

- Write an essay describing electrical hazards found in an imaginary house.

III. EXPERIMENTS

Complete a Circuit

Materials:
Students will need the materials listed (1 D-cell battery, 1 1.2-volt lightbulb, 1 E-10 lightbulb base, two 12-inch pieces of insulated solid strand 18-22 gauge copper wire with one inch of insulation removed at each end, masking tape). Bulbs, bases, and wire can be purchased at stores like Radio Shack. Make sure the lightbulbs and bases match.

Safety First:

- Students should be supervised by an adult while doing this experiment.
- A teacher or another adult should be responsible for stripping insulation from wires.
- Explain to students that electricity can be dangerous if it is not handled correctly, and emphasize they should never experiment with the electricity that comes from a wall outlet. It's much more powerful than the electricity made by small batteries and could seriously injure or even kill someone.

Objective:
Students will build a circuit and equate it to the path of electricity that comes from power plants.

Getting It Across:

1. Have students read the information and follow the steps on the page.
2. Make sure they are able to identify the circuit electricity travels from the battery to the lightbulb and back, and the circuit electricity travels from power plants to homes and back. They should be able to equate the wires in the experiment with power lines and electrical wiring in the electric distribution system.

Questions and Answers:

- What part of the distribution system is like the wires in the experiment? (Power lines and electrical wiring.) What happens if you only tape one of the wires to the battery? Why? (The bulb does not light. The circuit is not complete unless both wires are taped to the battery, allowing electricity to flow in a circle.)

Experiment with Conductors and Insulators

Materials:
Students will need 1 D-cell battery, 1 1.2-volt lightbulb, 1 matching lightbulb base, one 12-inch piece and two 4-inch pieces of insulated solid strand 18-22 gauge copper wire with one inch of insulation removed at each end, and masking tape. Bulbs, bases, and wire can be purchased at stores like Radio Shack. Make sure the lightbulbs and bases match. Students will also need a variety of things they think might conduct electricity, such as toothpicks, rubber bands, paper clips, plastic, fruit, etc.

Safety First:

- Students should be supervised by an adult while doing this experiment.
- A teacher or another adult should be responsible for stripping insulation from wires.
- Explain to students that electricity can be dangerous if it is not handled correctly, and emphasize they should never experiment with the electricity that comes from a wall outlet. It's much more powerful than the electricity made by small batteries and could seriously injure or even kill someone.

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 liquids 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.

Objective:
Students will learn the difference between conductors and insulators.

Getting it Across:

1. Have students bring in things they think might conduct electricity.
2. Have teams read the information and follow the steps on the page.
3. Students should first test their circuit by connecting it without any trial material.

Questions and Answers:

- Ask teams to share their predictions and results. Were the results the same? If not, why not? (Answers will vary. Be sure the experimental setup was not at fault.)
- What conclusions can students draw about conductors and insulators? (Answers will vary. Students might generalize that metals are good conductors or plastic is a good insulator.)

Electricity and Water

Materials:
Students will need the circuits they made for the "Conductors and Insulators" experiment, plus a glass pint or quart jar, 2 nails, 2 alligator clips, salt, and water.

Safety First:

- Students should be supervised by an adult while doing this experiment.
- A teacher or another adult should be responsible for stripping insulation from wires.
- Explain to students that anything can conduct electricity when wet. Remind students that they can mix water and electricity safely in this experiment because the voltage is so minimal (1.5 V per D-cell battery).

Objective:
Students will demonstrate that water is a conductor of electricity.

Getting it Across:
Be sure students add plenty of salt to the water. Then have them predict, experiment, and note their observations. Share results.

Questions and Answers:

1. Ask students why they think the salt is needed. (Students will need to add a lot of salt to their water in order for electric current to flow. The voltage of the battery is so low that additional particles must be added to make the water MORE conductive. It is the impurities in water that make it a good conductor. Pure water will not conduct electricity. However, pure water is only found in the laboratory. That's why there is so much emphasis on the conductivity of water as regards electrical safety.)

Ben Franklin Was Lucky!

Materials:
Students will need the circuits they made for the "Complete a Circuit" experiment, modified as shown in the illustration (strip a 1-inch section of insulation off the middle of each wire). Students will also need a 6-inch piece of thicker wire with one inch of insulation removed at each end.

Safety First:

- Students should be supervised by an adult while doing this experiment.
- A teacher or another adult should be responsible for stripping insulation from wires.
- Remind students that they are able to work with these batteries and wires because the voltage is minimal (1.5 V per D-cell battery). They should never experiment with the electricity that comes from a wall outlet. It's much more powerful than the electricity made by small batteries and could seriously injure or even kill someone.

Objective:
Students will be able to describe a short circuit and compare it to the story about Ben Franklin.

Getting it Across:

1. Have students read the information and follow the steps on the page.
2. Be sure students understand that they should immediately disconnect the thick wire and the battery after they observe what happens. The wires will get hot. This is a clue to why Franklin got shocked.

Questions and Answers:

- Students' predictions and results will vary.
- Why is this called a "short circuit"? (Because the electricity travels a shorter route than the intended circuit. Electricity is not able to complete its intended path because the circuit is grounded somewhere.)
- Why did Ben Franklin get shocked? (His arms functioned like the thick wire in the experiment. Electricity traveled through his body instead of through the circuit, and he got shocked.)