Electrical Safety World | Teacher's Guide

Site Overview

Along with parents, teachers play a key role in helping kids learn to stay safe around electricity. This section contains the resources you need to put this website to work for your class. We've included content standards-based information and experiments, plus worksheets to help you assess students' understanding of key science and safety concepts.

- Site Overview
- Electricity FAQs
- Experiment Tips
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- Going Further

Electrical safety is a critical issue for upper elementary and middle school children. While they may be capable of helping with chores and yard work, they are often casual about following safety precautions. In fact, in the United States each year, electrical shock or burns injure more than 4,000 children and kill about 25 kids under age 15.

Electrical Safety World uses information, experiments, games, and activities to teach students the principles of electricity and the practices of electrical safety.

This site is geared for a range of interests and reading levels and can be used by students in elementary and middle school. (Students can click on highlighted vocabulary words to access pop-up definitions.) Nonreaders will need adult assistance to play the games.

The site features four main areas:

- ***Games—***Interactive games that simulate common indoor and outdoor electrical hazards, giving students a chance to put safety principles into practice.

- ***For Kids***—Key science and safety content, organized into thematic sections. Each section is self-contained and includes relevant experiments or activities.

- ***For Parents***—Tips for how to get the most out of this site with kids. Includes handy checklists for home use, and links to useful safety websites.

- ***For Teachers***—You're in this area now! Tools and tips for educators.

Other helpful features include "Tell Me More," a section for students doing reports and research; a Safety Certificate that students can use to track their progress through the site; a handy Glossary; and a page of links to related energy websites.

Electricity FAQs (Frequently Asked Questions)

1. What is electricity?
2. How is electricity generated?
3. How does electricity travel?
4. How is electricity measured?
5. How many miles of power lines are there in the U.S.?
6. Do the words "shocked" and "electrocuted" mean the same thing?
7. Why can you sometimes see a spark if you can't see electricity?
8. When a circuit is open, do electrons go backward, or do they just stop?
9. Why does electricity try to get to the ground, and what does it do when it gets there?
10. Why can a bird stand on a power line and not get shocked?
11. What is static electricity?
12. What is lightning?
13. How much energy is in a bolt of lightning?
14. Does lightning ever strike fish?
15. Who holds the world's record for most often to be hit by lightning?
16. Why didn't Ben Franklin get electrocuted when he tied a metal key to a kite string and flew the kite in a thunderstorm?
17. Why shouldn't I use a corded phone or electrical appliance during a thunderstorm?
18. How do batteries create electricity?
19. Why don't I get a shock when I touch a battery?
20. Why is epilepsy described as an "electrical storm" in the brain?
21. What are those little boxes on hair dryer cords?
22. Do electric eels really create electricity?
23. How does a defibrillator work?
24. How does a light bulb work?

1. What is electricity?

Electricity is a form of energy that starts with atoms. Atoms are too small to see, but they make up everything around us. An atom has three tiny parts: protons, neutrons, and electrons. The center of the atom has at least one proton and one neutron. At least one electron travels around the center of the atom at great speed. Electricity can be created by forcing electrons to flow from atom to atom.

2. How is electricity generated?

Most electricity used in the United States is produced at power plants. Various energy sources are used to turn turbines. The spinning turbine shafts turn electromagnets that are surrounded by heavy coils of copper wire inside generators. This creates a magnetic field, which causes the electrons in the copper wire to move from atom to atom.

3. How does electricity travel?
Electricity leaves the power plant and is sent over high-power transmission lines on tall towers. The very strong electric current from a power plant must travel long distances to get where it is needed. Electricity loses some of its strength (voltage) as it travels, so transformers, which boost or "step up" its power, must help it along.

When electricity gets closer to where it will be used, its voltage must be decreased. Different kinds of transformers at utility substations do this job, "stepping down" electricity's power. Electricity then travels on overhead or underground distribution wires to neighborhoods. When the distribution wires reach a home or business, another transformer reduces the electricity down to just the right voltage to be used in appliances, lights, and other things that run on electricity.

A cable carries the electricity from the distribution wires to the house through a meter box. The meter measures how much electricity the people in the house use. From the meter box, wires run through the walls to outlets and lights. The electricity is always waiting in the wires to be used.

Electricity travels in a circuit. When you switch on an appliance, you complete the circuit. Electricity flows along power lines to the outlet, through the power cord into the appliance, then back through the cord to the outlet and out to the power lines again.

Electricity travels fast (186,000 miles per second). If you traveled that fast, you could travel around the world eight times in the time it takes to turn on a light! And if you had a lamp on the moon wired to a switch in your bedroom, it would take only 1.26 seconds after you flipped the switch for electricity to light the lamp 238,857 miles away!

4. How is electricity measured?
Volts, amps, and watts measure electricity. Volts measure the "pressure" under which electricity flows. Amps measure the amount of electric current. Watts measure the amount of work done by a certain amount of current at a certain pressure or voltage.

To understand how they are related, think of water in a hose. Turning on the faucet supplies the force, which is like the voltage. The amount of water moving through the hose is like the amperage. You would use lots of water that comes out really hard (like a lot of watts) to wash off a muddy car. You would use less water that comes out more slowly (like less watts) to fill a glass.

1 watt = 1 amp multiplied by 1 volt
1 amp = 1 watt divided by 1 volt

5. How many miles of power lines are there in the U.S.?
There are more than 500,000 miles of high-voltage transmission lines in the U.S. and many hundreds of thousands more miles of distribution lines that carry electricity to our homes.

6. Do the words "shocked" and "electrocuted" mean the same thing?
No! Someone can be *shocked* by electricity and survive. But when we say someone has been *electrocuted*, it means they have been killed by electricity.

7. Why can you sometimes see a spark if you can't see electricity?
You can't see electricity when it is flowing through a circuit. But if electricity leaves the circuit—like when someone is shocked—you can see a spark. The spark isn't electricity itself. It is a flame that happens when the electricity travels through the air and burns up oxygen particles.

8. When a circuit is open, do electrons go backward, or do they just stop?
Neither! In the wires of an electrical circuit, the electrons are always jiggling around. When a circuit is closed to run an appliance or a light bulb, the electrons jiggle a lot and travel through the wire. When the circuit is open, all the electrons just jiggle where they are—kind of like running in place.

9. Why does electricity try to get to the ground, and what does it do when it gets there?
It's just the nature of electricity to move from an area of higher voltage to an area of lower voltage, if given a path to travel there. The ground is simply the lowest-voltage area around, so if you give electricity a path to the ground, it will take it, no questions asked! When electricity goes into the ground, the earth absorbs its energy.

10. Why can a bird stand on a power line and not get shocked?
It is easier for electricity to keep flowing through the power line than to go through the bird. But if a bird with large wings touches a power line and a tree or power pole at the same time, it provides electricity with a path to the ground, and could be shocked. And if a bird touches two wires at once, it will create a circuit—electricity will flow through the bird and likely electrocute it.

11. What is static electricity?
The shock you feel when you touch an object after walking on carpet is static electricity. When you drag your feet across carpet on a dry day, electrons from the carpet get transferred to your body. If you then touch a piece of metal, such as a doorknob, the electrons jump to the metal and you'll feel a shock.

12. What is lightning?
Lightning is a large discharge of static electricity. During a thunderstorm, clouds build up a charge. When there is a big difference in charge between the cloud and its surroundings, the cloud discharges a lightning bolt.

13. How much energy is in a bolt of lightning?
One lightning strike can carry up to 30 million volts—as much electricity as 2.5 million car batteries.

14. Does lightning ever strike fish?
Yes, it does. Because water conducts electricity, when lightning strikes water it spreads out along the surface. Any fish near the surface of the water get electrocuted.

15. Who holds the world's record for most often to be hit by lightning?
According to the Guinness Book of Records, Roy G. Sullivan, a former U.S. park ranger, was struck by lightning seven times over the course of his 35-year career. Lightning has burned off his eyebrows, seared his shoulder, set his hair on fire, injured his ankle, and burned his belly and chest.

16. Why didn't Ben Franklin get electrocuted when he tied a metal key to a kite string and flew the kite in a thunderstorm?
Ben Franklin's famous key did give off an electric spark. But lucky for Franklin, the kite was just drawing small electrical charges from the air. If the kite had actually been struck by lightning, Franklin would have been killed!

17. Why shouldn't I use a corded phone or electrical appliance during a thunderstorm?
There is a very small chance that a lightning strike could surge through phone lines or through the wires of an electrical appliance. If you were to touch a phone or appliance at just that moment, you could be shocked.

18. How do batteries create electricity?
A chemical reaction within the battery forces electrons to move.

19. Why don't I get a shock when I touch a battery?
There is not enough voltage in a regular household battery to cause a shock. However, car batteries are powerful enough to shock so you should never tamper with them.

20. Why is epilepsy described as an "electrical storm" in the brain?
Nerve cells in the brain communicate with each other through tiny electrical signals. During an epileptic seizure, some or all of these cells suddenly begin to fire together, causing a wave of electrical energy that sweeps through the brain. Many muscles contract, or seize, all at the same time.

21. What are those little boxes on hair dryer cords?
In the early 1980s there were about 18 deaths a year caused by hair dryers falling into bathtubs or sinks filled with water. Since 1991, hair dryer manufacturers have been required to include GFCIs on the dryer cords. The number of hair dryer related deaths has dropped to an average of two per year.

22. Do electric eels really create electricity?
Yes! An electric eel uses chemicals in its body to manufacture electricity. A large electric eel can produce a charge of up to 650 volts, which is more than five times the shocking power of a household outlet.

23. How does a defibrillator work?
Inside the cells of the heart, tiny electrical currents fire in a steady rhythm. If that rhythm is disrupted due to disease or injury, a heart attack can occur. A defibrillator shocks every cell in the heart at the same time, so they all start up again in rhythm. It's like each cell is dancing to the same beat!

24. How does a light bulb work?
The wire inside a light bulb is called a filament. It is made of tungsten, a metal that stays solid at very high temperatures. Electricity flows through the tungsten filament, causing it to heat up and glow. The glow gives off light. Inside a light bulb is a vacuum—in other words, all the air has been removed from inside the glass bulb. (If there were air inside, the wire would burn up.)

Experiment Tips

Here you'll find guidance and tips for the four science experiments on this website:

- Complete a Circuit
- Conductors and Insulators
- Electricity and Water
- Ben Franklin Was Lucky!

Complete a Circuit

Materials:
Students will need the materials listed (1 D-cell battery, 1 1.2-volt light bulb, 1 E-10 light bulb base, two 12-inch pieces of insulated solid strand 18-22 gauge copper wire with 1 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.
- Explain to students that electricity can be dangerous if it is not handled correctly, and emphasize that 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:

Have students read the information and follow the steps on the page. 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 tape only 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.)*

Conductors & Insulators

Materials:

Students will need 1 D-cell battery, 1 1.2-volt light bulb, 1 matching light bulb base, one 12-inch piece and two 4-inch pieces of insulated solid strand 18-22 gauge copper wire with 1 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 light bulbs 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 that 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 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.

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 & Water

Materials:
Students will need the circuits they made for the "Conductors & 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:
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 1 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:

Through creating a short circuit, students will understand that Ben Franklin got shocked because he touched two parts of a circuit at the same time.

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.)*

Investigate Your School's Energy Habits

This activity is for students in grades 7-8. It appears in the section "Tell Me More/Energy Efficiency." The activity requires research and math skills.

Students will probably need you to walk them through the calculations. You can use the sample calculations below, which are based on estimates. Your school's lighting costs, hours, number of lights, and electricity costs will vary from the example.

1. Choose a representative to speak with the head custodian about existing lights.
2. Contact a lighting store to find the most efficient lights to replace the existing ones. Find out:
   - **How much energy do new lights use?** New lighting uses 50 watts for each 8-ft. fluorescent compared to 75 watts for old lighting. Electronic ballasts increase efficiency of the lighting system.
   - **How many hours do they last?** Tubes last for approximately 20,000 hours of use.
   - **How much do they cost?** Replacement cost = $12 per tube and $40 per fixture.
3. **How many will be needed?** 300 8-ft. tubes and 150 ballasts.
4. **How long are the lights on per year?** 1,400 hours/year.
5. **Total Watt-hours per year for both systems**: <u>Old system:</u> 1,400 hours/year x 300 tubes x 75 watts = 31,500,000 Watt-hours/year. This is the same as 31,500 kWh/year. <u>New system:</u> 1,400 hours/year x 300 tubes x 50 watts = 21,000,000 Watt–hours/year. This is the same as 21,000 kWh/year.
6. **Annual cost of running the different systems:** I electricity cost per kWh is 10¢, then cost for each system is:
   Current system: 31,500 kWh/year x $0.10/kWh = $3,150/year
   New system: 21,000 kWh/year x $0.10/kWh = $2,100/year
   Savings from electronic ballast of 35%: $2,100 x 0.35 = $735
   Total savings = kWh svgs + electronic ballast svgs = ($3,150/year – 2,100/year) + $735/year = $1,785/year
7. **How long will it take to pay off the new lights?** New system cost = (300 x $12) + (150 x $40) = $3,600 + $6,000 = $9,600. (Consider that old tubes and ballasts would need replacement anyway, so the additional cost of the new system will be as high as this figure). If 1/3 of the tubes and ballasts needed replacing, then the real cost would be $6,400. It would take about three and a half years for the energy savings to pay off the cost of the new equipment.
8. Share results with principal or custodian.
9. **Other energy uses:** energy for heating and air conditioning; electricity for classroom, office, and cafeteria equipment; fuel for school buses, etc.

Student Worksheets

- The Travels of Electricity
- How Electricity Can Hurt You
- Tree & Power Line Safety
- In Case of Emergency
- Tell Me More
- Answer Keys for All Worksheets

These one-page worksheets review the key safety principles from the main thematic sections of *Electrical Safety World*. Here are some ideas for how to use them with your class:

- For younger students, use the questions to orally review basic electrical safety information with the whole group.

- For older students, assign a section or sections of the site to individual students or small groups, and ask students to use the worksheets like a treasure hunt, completing them as they find the answers in each section.

- 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.

Electrical Safety World
Student Worksheet #1

The Travels of Electricity

Name: ___________________________________ Date: ______________________

1. You can move faster than electricity can. (True or False)

2. Circle three objects from the list below that conduct electricity:

an aluminum ladder	rubber lineman's gloves
a copper wire	a metal bench
a fiberglass ladder	a glass insulator

   What these objects have in common is that they are made of

   ____.

3. Insulators are important for safety around electricity because

   ____.

4. Plugging too many things into an outlet can overload it and cause

   ____.

5. Guess whether the power lines to your building are overhead or underground. Now look outside. Were you right? ________________.

6. Use the following three items—a D battery, a lightbulb, and two pieces of wire—to draw a complete electric circuit that will allow the bulb to light up.

Electrical Safety World
Student Worksheet #2

How Electricity Can Hurt You

Name: ___________________________________ Date: ______________________

1. Electricity always takes the easiest path to the ___________
   a) sky b) tree c) ground

2. You have to be touching the ground directly to be shocked by electricity.
   (True or False) ____________________.

3. You should never touch anything electrical while you have wet hands or while standing in water because

   ____

   ____.

4. Draw a picture of a dangerous situation inside or outside a home that could result in someone being shocked by electricity.

5. Now, explain something people could do to correct the shock hazard you just drew.

Electrical Safety World
Student Worksheet #3

In Case of Emergency

Name: ___________________________________ Date: ______________________

1. What can happen if you throw water on an electrical fire? What should you do instead for an electrical fire?

2. If you touch someone who has been shocked and they are still contacting the source of the electricity, what could happen to you?

3. What is the only safe thing to do if you see a fallen power line?

   a) jump over it
   b) stay far away from it and tell an adult
   c) move it with a stick

4. What is the safest thing to do if you are in a car with a power line on or near it?

   a) climb out the car window
   b) stay in the car
   c) get out of the car as fast as you can
   d) get onto the car roof and stay there

5. List 3 things that would be useful to have in a safety kit during a power outage.

   ____

   ____

   ____

6. If you see lightning or hear thunder and can't get indoors, you are safest

   a) under a tree
   b) in a hardtop car
   c) on a wooden bench
   d) in a wooden boat on a lake

Electrical Safety World
Student Worksheet #4

Tree & Power Line Safety

Name: ___________________________________ Date: _______________________

1. What are two problems that could happen if a tree branch touches a high-voltage power line?

2. True or False: Even if they are not sparking or humming, fallen power lines can kill you if you touch them or the ground nearby. __________________

3. Why is it important to call the underground utility locator service before planting a tree or doing other types of deep digging?

4. True or False: Anyone can trim trees near high-voltage power lines if they get the local electric utility's permission first. __________________

5. If your kite gets caught in a tree near a power line, why is it dangerous to try to get it down?

6. If you are going to plant a tree, how far away from high-voltage power lines should you dig the hole?

   a) 10 feet away

   b) far enough so when the tree is fully grown, it will be 10 feet away from the lines

   c) far enough so when the tree is fully grown, it will be 20 feet away from the lines

Electrical Safety World
Student Worksheet #5

Tell Me More

Name: ___________________________________ Date: _______________________

1. Explain what “renewable” means, and give two examples of renewable energy resources.

2. What role does an electromagnet play in generating electricity?

3. Name three electrical inventors and their inventions.

4. If you could invent any sort of device to make kids’ lives easier or more fun, what would it be? Draw a picture of your invention.

5. What is one way you could reduce energy waste at home or at school?

Worksheet Answer Keys

These one-page worksheet answer keys correspond to the student worksheets from the main thematic sections of *Electrical Safety World*.

- The Travels of Electricity
- How Electricity Can Hurt You
- Tree & Power Line Safety
- In Case of emergency
- Tell Me More

Electrical Safety World
Worksheet #1 Answer Key

The Travels of Electricity

1. False. Electricity travels at the speed of light. You cannot move faster than electricity.

2. An aluminum ladder, a copper wire, and a metal bench conduct electricity. What these objects have in common is that they are made of metal.

3. Insulators are important for safety around electricity because they are materials that do not allow electricity to pass through them easily. Insulators keep electricity from leaving power lines and appliance power cords so it cannot shock you.

4. Plugging too many things into an outlet can overload it and cause a shock and fire hazard.

5. Answers will vary.

6. Illustrations will vary but should show a path that provides a complete, uninterrupted loop from the battery to the bulb and back to the battery.

Electrical Safety World
Worksheet #2 Answer Key

How Electricity Can Hurt You

1. Electricity always takes the easiest path to the ground (c).

2. False. You do not have to be touching the ground directly to be shocked by electricity. You could be touching something that is touching the ground, like a ladder.

3. You should never touch anything electrical while you have wet hands or while standing in water because water conducts electricity and you could be shocked.

4. Illustrations will vary; they should clearly show electrical hazards.

5. Answers will vary but should include prevention or correction of electrical hazards depicted in #4.

Electrical Safety World
Worksheet #3 Answer Key

In Case of Emergency

1. Water conducts electricity so if you throw water on an electrical fire it could make the fire bigger and spread it, or you could be shocked. You should tell an adult to use a multipurpose fire extinguisher instead.

2. If you touch someone who has been shocked and they are still contacting the source of the electricity, you could be shocked, too.

3. b) If you see a fallen power line, the only safe thing to do is to stay far away from it and tell an adult. If you jump over it or try to move it with a stick you could be seriously hurt or even killed.

4. If you are in a car with a power line on or near it, the safest thing to do is b) stay in the car.

5. Items that would be useful to have in a safety kit during a power outage include: flashlight, matches, extra batteries, radio, can opener, extra food, first aid supplies, extra water, etc.

6. If you see lightning or hear thunder and can't get indoors, you are safest b) in a hardtop car.

Electrical Safety World
Worksheet #4 Answer Key

Tree & Power Line Safety

1. If a tree branch touches a high-voltage power line, the branch could catch fire, a power outage could occur, or someone could climb the tree and be shocked by the power line.

2. True: Even if they are not sparking or humming, fallen lines can kill you if you touch them or the ground nearby.

3. It is important to call the utility locator service before planting a tree or doing other types of digging to make sure that when you dig a hole you will not contact underground power lines and other utilities.

4. It is false that anyone can trim trees near high-voltage power lines if they get the local electric utility's permission first. Only specially trained, qualified tree-trimmers are allowed to work on trees near high-voltage power lines.

5. If your kite gets caught in a tree near a power line, it is dangerous to try to get it down because you might contact the power line while trying to get the kite, and then electricity could travel through you on its way to the ground and you could be shocked.

6. If you are going to plant a tree, you must plant it b) far enough away from high-voltage power lines so when the tree is fully grown it will be 10 feet away from the lines.

Electrical Safety World
Worksheet #5 Answer Key

Tell Me More

1. Renewable means something can be replenished in a short period of time, so it will never be all used up. Biomass, geothermal energy, hydropower, ocean energy, wind power, and solar energy are examples of renewable energy resources.

2. When electromagnets spin near copper wire it creates a magnetic field, which causes the electrons in the wire to move from atom to atom. The movement of electrons creates electric current.

3. Students' answers may include the notable inventors and inventions listed on this site: Alexander Bell and the telephone, Thomas Edison and the incandescent light, Michael Faraday and the generator, Benjamin Franklin and the lightning rod, Lady Augusta Ada Byron and the binary programming code, Lewis Latimer and the light bulb's carbon filaments, or Granville Woods and the railroad telegraph system. Or, students may describe less-prominent inventors and inventions not listed on this site.

4. Students will draw various inventions to make kids' lives easier or more fun.

5. There are many ways to reduce energy waste at home or school. Answers will vary but should demonstrate students' understanding of how to use electricity less and/or how to use it more efficiently.

Going Further

Here are some assignment ideas to help your students take their electrical savvy to the next level:

- 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 extremely dangerous imaginary house.