

Risk Watch® Electrical Safety Lesson Plans

Grades 7-8

Understand the Science of Electricity

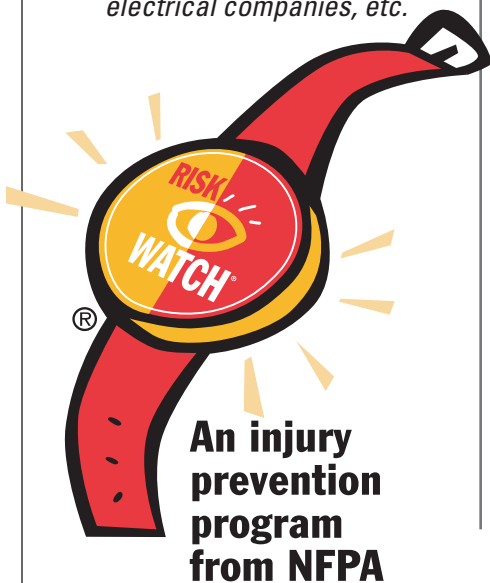
Lesson Plan: The Shocking Truth about Electricity

Objectives

Articulate the basics of the science of electricity as related to specific electrical hazards.

Preparation

1. Review *Electrical Information Guide*.
2. Download photos or actual items listed below to use for discussion and demonstration purpose:
 - Two- and three-pronged electrical outlet
 - Outlet safety plug
 - Extension cord
 - Power strip
 - Frayed electrical cord
 - Overloaded electrical outlet
 - GFCI
3. Collect prizes for correct answers. Incentives might include pencils, items from fire department giveaway collections, mugs from electrical companies, etc.



Procedure

1. Introduce this review game:

"Let's take a look at 10 common beliefs concerning home appliances and electrical hazards. The answers to some of the 10 statements are true, others are false. As caretakers of siblings, as babysitters in your community, your fast actions and knowledge of these facts can prove life saving for you and for those you are charged to care for."
2. Give an incentive to the student with the first correct True/False answer - backed up with a corrected statement if the provided statement is false.
 1. If you talk on the phone (not cordless phone) during a lightning storm you can be electrocuted through the phone lines.
 2. You may be shocked by sticking a metal utensil into a toaster.
 3. Outlet caps are 100% "toddler proof."
 4. A pet that chews on an electrical cord may be electrocuted.
 5. An iron that is left on and sitting upright all day will start a fire.
 6. You can't overload a multi-plug power strip.
 7. Older holiday lights are probably safe.
 8. If an appliance smells funny, or doesn't work exactly right, it will be ok to use for a little longer.
 9. Ground fault circuit interrupters are only for outside use.
3. During an electrical emergency:
 1. TRUE
Landline phones in homes work with electricity. It is better to stay off the phone during an electrical storm. The point is that the phone line is a potential conductor for a lightning strike.
 2. TRUE
You may become the path of least resistance to the ground. If the toast gets stuck, unplug the toaster before attempting to remove the stuck item.
 3. FALSE
Electricity continues to flow through the wires in the walls. Children have been known to try to suck on the outlet caps-plugged into the wall! The best solution is to constantly watch the children.
 4. TRUE
Once the insulation is broken, the raw electricity can escape. Some pets are born chewers. Rabbits, puppies, and kittens are notorious for chewing on cords. Keep cords out of reach of pets and children.
 5. FALSE
It may or may not start a fire. Some irons today have a shut-off feature that will make the iron turn off if not used in a certain amount of time.



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6. FALSE

Yes, you can overload the multi-plug extension power strips. Check to be certain the ones in place at home have a circuit breaker built into the power strip. This will shut off the power strip if too much voltage is demanded.

7. FALSE

Holiday lights did not have the cool feature prior to the 1980s. The electricity flowing through the bulbs made it hot enough to catch items on fire.

Also, the insulation on the cords of the older lights cracks and wears out. It pays to replace old holiday lights.

8. FALSE

If an appliance smells funny or doesn't work exactly right, tell an adult. It is not "OK." Slower heating or signs that the product does not perform like it used to may be signs of an electrical problem.

9. FALSE

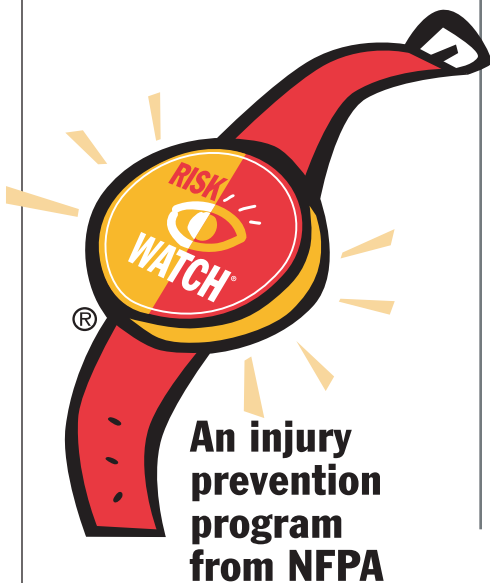
GFCIs are to be used in bathrooms and kitchens near the sink, as well as for outdoor outlets. GFCIs detect electrical current leakage and immediately shut off the power so no one is injured.

Other safety reminders:

- If you notice arcing, a burning smell, or smoke coming from an appliance, turn off the power, get out of the house, and call 9-1-1.
- Stay away from downed power lines. Call 9-1-1 to identify the problem.
- If you are in a vehicle when a power line falls on it, stay in the car. Wait until the fire department arrives.
- If someone is in contact with live wires, don't touch the person. Call 9-1-1. Wait for the power to be turned off.

Extension: Invite outside experts to discuss safety equipment used.

Invite a firefighter and an electrical lineperson to talk about and demonstrate their safety gear. Ask the firefighter to place extra emphasis on showing the safety features built into the coat and the fact that even with this gear the firefighter is not safe around electricity. The power must be turned off. Ask the electrical lineperson to also focus on the equipment worn and note the differences between his/her gear and how these relate to specific actions taken that would be different than the fire personnel.



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TEST
MONTHLY

TEST
RESET

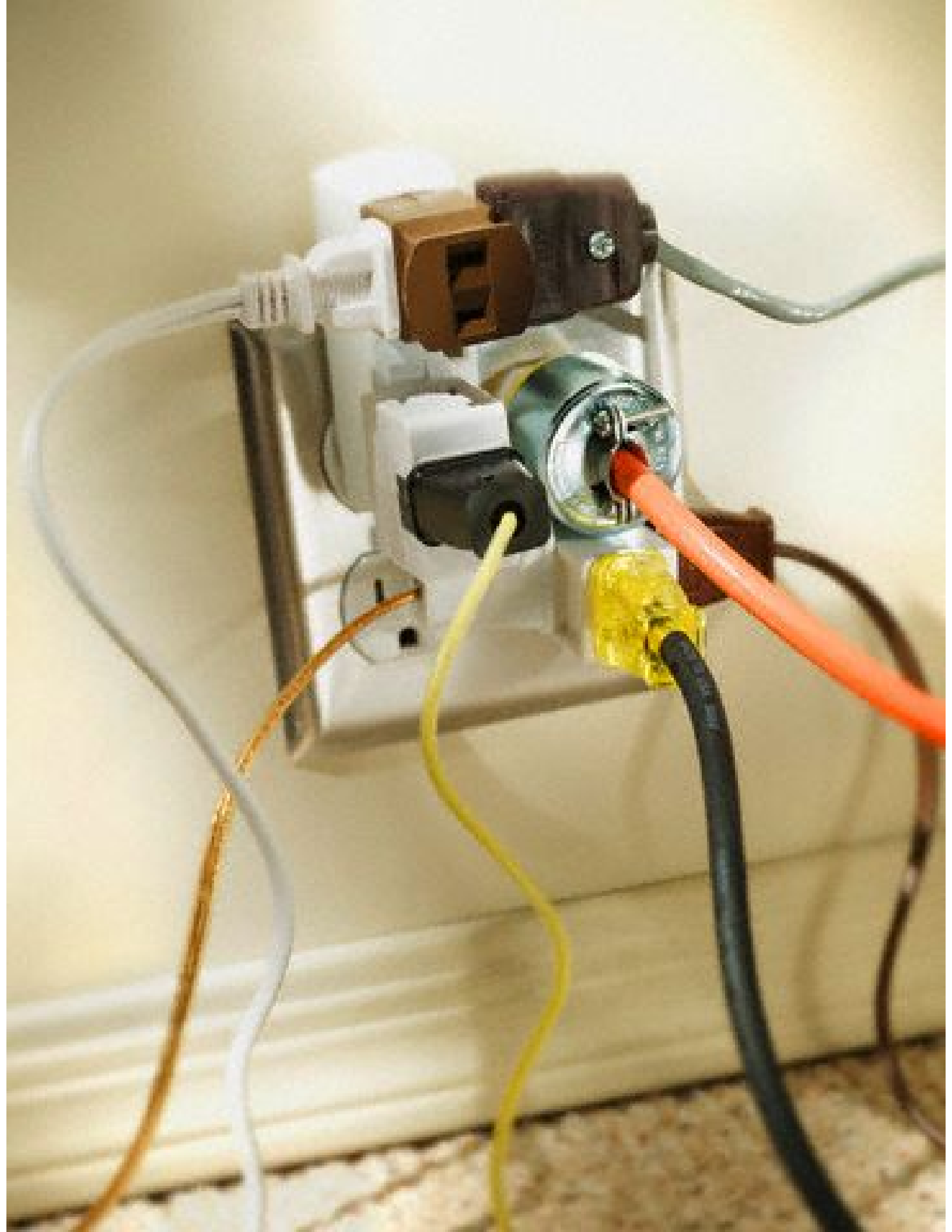
RESET
TEST

SEE
INSTRUCTIONS

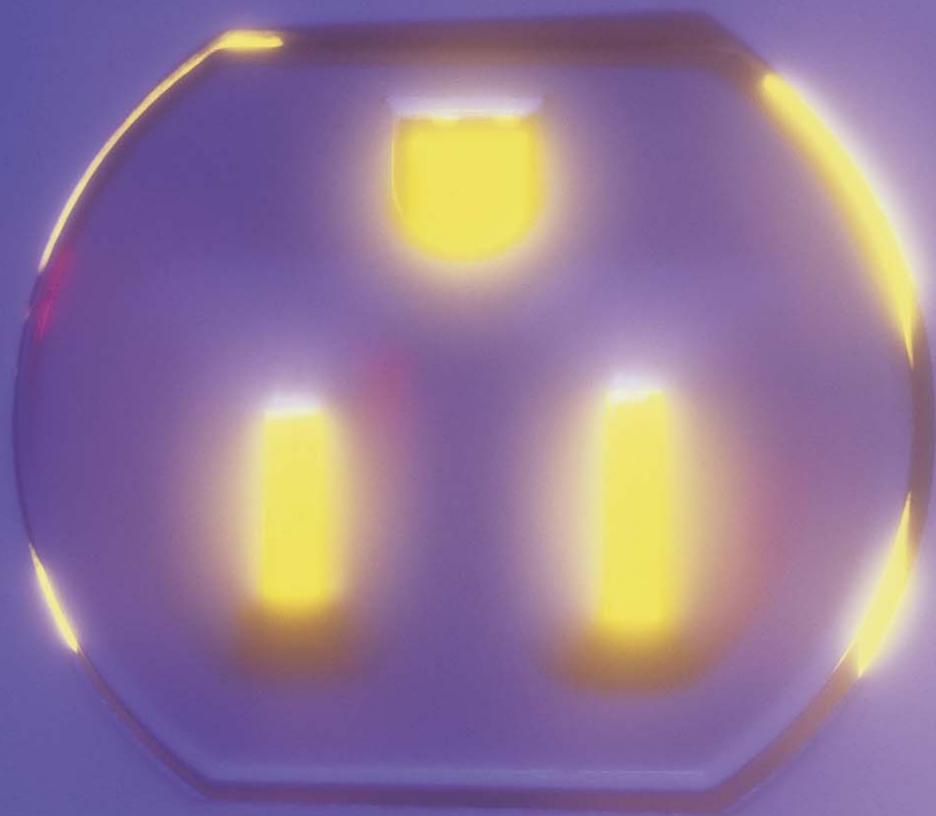


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Electrical Information Guide

1. Understand the science of electricity.

Electricity is a powerful natural phenomenon, a form of energy and a basic feature of the universe's matter. Learning to respect the power of electricity is vital.

Today, many, many areas of human life depend on electrical energy. In the home, in the work place, for communications, transportation and for medical sciences: machines and appliances, subways and convey belts, motors and cranes, elevators and escalators all function to make life easier.

While electricity makes these and many other items run, there remain other fascinating characteristics of electricity to understand. Electricity is sent along overhead and underground power lines to get it where it is needed. Electricity is waiting in the wires of the house to be used. Electricity travels at the speed of light, 186,000 miles per second, making it impossible for a human to move from its path and power. That's why prevention and knowledge remain critical tools in the electrical safety tool chest.

Electricity continuously searches for the paths to the ground. Often electricity will take shortcuts off the path we intend for it to take. If an object that conducts electricity provides an easier path to the ground, the electricity will follow *that* path. It takes all paths to ground, probably most going by the path of least resistance.

Conductors

Conductors provide electricity as a means to travel. Metals and water are good conductors for electricity. Electricity locates a conductor, like water, metal, wet wood, or a human body and follows that conductor's path to the ground.

If a person touches an electrical wire or a faulty appliance, electricity will likely follow the shortcut path and pass through the person to the ground. As the electricity flows through the person, he or she may be seriously hurt or killed. Even if the person is not directly touching the ground, but is touching something in contact with the ground, like a tree or a ladder, that person can unintentionally become a conductor of electricity.

Because water is such an excellent conductor of electricity, electricity and water are not safe together. The human body contains 70% water. This explains why the body becomes an electrical conductor so readily. It is also why appliances,

electrical equipment, and tools must be kept away from bathtubs, puddles, sinks, and wet hands. People must be certain that their hands are dry and that they are not standing in water or on damp ground if touching anything electrical.

Water must never be used to extinguish an electrical fire because of its conductor capabilities. A multipurpose (ABC) fire extinguisher should be used instead.

Insulators

Insulators help keep electricity where it belongs. Glass, rubber, plastic, dry wood, and dry air make excellent insulators. Insulators are important for electrical safety because they keep the electricity from leaving the wires that electricity is meant to travel along.

Insulators make household cords safer to touch. Most cords are made from conducting materials covered with an insulating material such as rubber or plastic. Protective insulated cords and coverings help keep people safer from the electricity inside an appliance.

It is important to use appliances and cords in the way they were designed to help keep the interior electrical parts in tact. If a broken or a live wire inside a cord becomes exposed, a person touching the tool, toaster, or curling iron could easily come into contact with the electricity.

Current

No one invented electricity. People created inventions to harness the power of electricity. Scientists worked with electricity to develop light bulbs and batteries, and circuits and automatic defibrillators...Very simply, electrical current is a flow of electrical charge through a conductor. Hence, electricity is defined as the movement of charged particles. Electrical current is a form of energy associated with the movement of electrons and protons. While the current flows through an electrical device, energy can be converted to useful forms. For instance, electrical energy is used to heat the bread in a toaster and to create the light in a light bulb.

The electrical current that most people come into contact with harbors three hazards: shock, fire, and burns.

Electrical Fires

Electrical fires are different than other fires. Because water conducts electricity, putting water on an electrical fire can put more people in danger of electrocution, including those fighting the fire.

Electrical Fire Facts

- NEVER use water on an electrical fire.
- An adult should turn off the main power to the house.

- Call 9-1-1 and report an electrical fire.
- A multipurpose ABC fire extinguisher may be used to extinguish the fire.

Electrical Injury

The electricity in one 7.5-watt holiday tree bulb can kill a person in less than one second* if it passed through the chest (Data source: Electrical Safety at Home and Work” The Culver Company, Product 42110, run # 6048, 1996). Even if not fatal, electrical injury may cause serious falls, burns, cuts, or internal bleeding. The injury from that holiday light or a 12-watt electric shaver, a 75-watt bulb, or a 1,400- watt hair dryer could be fatal. Even when an appliance is turned off, but left plugged in, it can provide an injury. It is important to unplug an appliance when not in use and also before cleaning or working on it.

Electrical Burn

When a person is shocked, tissue along the path the electrical current takes through the body is burned. Burns occur anywhere along the path that the electricity takes, including areas on the skin where the current enters and leaves the body. Electricity is said to burn from the inside out. Tissue burned inside the body along the path continues to burn even after the current is stopped. While some electrical burns *look* minor, there still may be serious internal damage especially to the heart, muscles, or brain.

A number of factors define the outcome of an electrical injury to a person.

- The intensity of the voltage to which the person was exposed.
- The length of time exposed to the current.
- The route the current passed through the body.
- The speed and appropriateness of the delivered treatment.
- The victim’s state of health.

The symptoms of electrical injury may include:

Skin burns
 Numbness, tingling
 Weakness
 Muscle contractions
 Muscular pain
 Bone fractures
 Headache
 Hearing impairment
 Seizures
 Heart arrhythmia
 Cardiac arrest
 Respiratory failure
 Unconsciousness

The most serious cases involve loss of life and loss of limbs.

First Aid in Electrical Emergency Situations

1. Call 9-1-1 for medical and rescue assistance.
2. Shut off the electrical current, if safely possible. This could mean unplugging a cord, removing a fuse from the fuse box, or turning off a circuit breaker. Often simply turning off the appliance will not stop the flow of electricity.
3. If the current can't be turned off, wait for help to arrive. Stand back. If there is no help around, a non-conducting object like a broom or a chair could be used to push the victim away from the source of the current. It's best just to wait for help, however, to avoid adding yourself as another victim.
4. Once removed from the electrical current, if the victim is faint, pale, or shows signs of shock, lay him/her with the head slightly lower than the main part of the body and feet elevated. Cover the person with a warm blanket and wait for help to arrive. Provide no food or water.

Stay vigilant. Respect the power of electricity.

Electricity is a phenomenal and powerful performer.

It is also disfiguring, disabling, and deadly.

In most cases, electrical injuries can be foreseen and avoided.

2. Identify and work to eliminate electrical safety hazards in the home.

The best way to keep the home safe from electrical hazards is to take good care of appliances and to use all electrical equipment with care. While May is National Electrical Safety Month, respect for electricity and the power it provides must occur every day throughout the year.

According to the U.S. Consumer Product Safety Commission (CPSC), 400 total unintentional electrocutions occurred in the United States in 2000. Of these incidents, 150 were related to consumer products. Of those, 10 from household wiring; 17 related to small appliances; 29 related to large appliances; 15 related to power tools; 22 ladders; 3 garden or farm equipment; 12 lighting and 2 related to antennas. Seventeen electrocutions involved miscellaneous items such as unspecified appliances, pipes, poles, fences, chains, and flying toys (Data source: Electrical Safety Foundation International, ESFi).

According to the National Fire Protection Association's (NFPA) statistics for 1999-2001, electrical distribution equipment, including wiring, outlets, and lighting were involved in an estimated average of 35,000, or 9%, of the reported home fires per year. These fires caused an estimated average of 280 civilian fire deaths, 1,090 civilian injuries, and \$744 million in direct property damage.

Electrical problems can be a factor in fires started by appliances and other products powered by electricity. Electrical problems, including short circuits, ground faults and overloads, were contributing factors in roughly one in every five reported home fires, including those started by electrical distribution equipment.

According to Electrical Safety Foundation International (ESFi) an estimated 910 lives are lost, nearly 7,000 people injured, and nearly \$1.7 billion in property damage and loss due to fires started by equipment powered by electricity.

According to Carol Scott, burn nurse at Shriners Hospital in Boston, they see more electrical injuries from the international population than from the United States. (There are more people living abroad than in the United States. We don't know the risk.) In a continued effort to lower the number of deaths and injuries caused by electricity across the world, it is important to recognize the major causes of electrocutions and electric fires and then work to eliminate these hazards, before more lives are affected.

Most electrical devices have safety features to help prevent shock. Many appliances and tools have plugs with a third prong that connects the metal parts of the device to a wire leading to the ground. If the wiring inside the device becomes defective the third prong can carry any stray current safely to the ground.

The large box-like device found on the end of some appliance cords like that of hair dryers could be an appliance leakage circuit interrupter (ALCI) an immersion detection circuit interrupter (IDCI) or a ground-fault-circuit-interrupter (GFCI). These three-circuit interrupters protect people from unintentional electrocution and shock by immediately shutting off the power to the appliance when an electrical “leak” of current occurs.

A polarized plug has one narrow and one wide prong. The plug can only be inserted into a socket one way. This ensures the proper flow of electric current and lowers any chance of shock.

Make sure electrical items are certified by an independent testing lab such as UL, FM, CSA, or ETL. This ensures that the items have been tested for safe use.

**Is Your Home S (afe)
 A (nd)
 F (ree) from
 E (lectrical dangers)?**

Check to see how SAFE your home rates.

Electrical cords are in good condition.

- Check electrical cords for frays or nicks indicating excessive wear.
- Check that plugs fit snugly into sockets.

Electrical wall outlets are not overloaded with too many plugs.

- Check 1:1 ratio: one plug to each socket.
- Check for flickering lights, even after bulbs replaced.
- Check for outlets that emit sparks or smoke. Check that outlets and the wall immediately surrounding them are not discolored due to heat build-up.

Electric appliances are away from water sources.

- Check bathrooms, kitchens, and garages.

Electrical cords are placed where they will not become a tripping hazard, but not run under rugs, where they can overheat to cause a fire.

Electrical appliances with loose plugs and prongs are replaced.

Small appliances are turned off and unplugged after use.

Safety caps are placed in outlets to protect young children.

Extension cords are not in continuous use. When using an extension cord, follow these instructions.

- Unplug and safely store extension cords after every use
- Store cords loosely coiled in a dry place.
- Use properly rated cords for their *intended* use only.
Indoor vs. outdoor use
Proper gauge or size for the demand of the appliance or tool
- Check the rating on the cord. It must be the same or higher than the number of watts used.
- Select appropriate length.
Over 100 feet, power begins to be lost.
- Unwind cord before using.
- Connect plugs completely.
Push plugs all the way into outlet socket.
Never “daisy-chain” cords connecting multiple sets together for more length.
- Use the proper wattage light bulbs in light fixtures and lamps.
- Pull on the plug head, never on the cord.
- Never carry an appliance by its cord.
- Turn off and request that grown-ups repair or safely dispose of appliances that sputter, stall, or give slight shocks.
- Keep anything that will burn away from light bulbs or portable heaters.
- Use electrical tools or appliances only when hands are dry and when standing on dry ground. Standing in water or on a damp floor while using electrical appliances can be very dangerous.
- Check and remind adults to replace overheating cords and wall plates.
Notify an adult when you find an overheating cord or wall plate. They should be checked for problems and repairs or replacements made immediately.
- When disposing of damaged or defective cords or appliances, cut the cord to help ensure no one else “salvages” it and takes the hazard home with them.

Ground-fault-circuit-interrupters (GFCIs)

A ground fault occurs when electricity travels outside an intended path to get to ground, because of a frayed wire or faulty device. The current is leaking somewhere and electricity is escaping to the ground. If a person's body provides a path to the ground for this leakage, s/he could be injured, burned, or electrocuted. Ground-fault-circuit-interrupters (GFCIs) protect people from this.

Make certain GFCIs cover each circuit near a water source. GFCIs are located in outlets and circuit breaker panels. GFCIs are inexpensive electrical devices that can monitor electrical circuits to prevent electrocution, burns, and shocks. The GFCI will cut the power if it detects that the current is leaking off the circuit and may be traveling through the person (Data source: Electrical Safety Foundation International, ESFi).

GFCI protection should be found in bathrooms and garages, near kitchen sinks and outdoors.

Test smoke alarms and GFCIs monthly.

To test a GFCI:

GFCIs should be tested monthly to be certain they are working properly.

To test the GFCI, plug a light or nightlight into the outlet. The light should be on. Press the "TEST" button on the GFCI. The GFCI's RESET button should pop out and the light should go out.

If the light does not go out, the GFCI is defective or has been improperly wired. Contact an electrician to repair or replace the GFCI.

If the RESET button does not pop out, the GFCI is defective and should be replaced.

If the GFCI is functioning correctly and the lamp goes out, press the RESET button to restore the power to the outlet.

Arc-fault circuit-interrupters (AFCIs)

AFCIs are electrical safety devices designed to prevent fires caused by dangerous electrical arcs. When an electrical switch is opened or closed, an arc,

or discharge of electricity across a circuit, occurs. Unintentional arcs can occur at loose connections or where wires or cords have been damaged. Such arcs can lead to high temperatures and sparking, possibly igniting combustibles. AFCIs protect against fire by continuously monitoring the electrical current in a circuit and shutting off the circuit when unintended arcing occurs. These devices are designed to discriminate between unintended arcing and the type of arcing that occurs when a switch is operated.

Electricity is measured in volts, amps, and watts.

Volts measure the electrical potential.

- Volume of water.

Amps measure the *amount* of electrical current.

- Rate at which water flows through pipe.

Watts measure the amount of work done by a certain amount of current at a certain voltage.

- Work done by flow of water (water wheel, erosion) or wind, air movement (kite flying or buildings being ripped apart).

Volts x Amps = Watts

3. Identify outdoor electrical safety hazards.

A number of electrical safety hazards can be found outdoors. Children don't always recognize the dangers. It is important to remind them of the hazards, making them aware of the warning signs.

Recognize "Danger—High Voltage" signs

Many locations post warning signs telling of impending danger. Children must recognize and obey the "*Danger-High Voltage-Do Not Enter*" signs. Warning signs should be posted at substations and beside transformers to alert children these are not areas to play in or around. Substations and transformers contain dangerous electrical components.

Overhead power lines have no insulation. Carrying sometimes over 500,000 volts of electricity, there is no question what has more power, a child shimmying up the pole to reach a kite, or that power line over head. Underground power lines are insulated, but a sharp shovel will quickly break through that insulation and create a dangerous hazard.

- Stay away from overhead or buried power lines.
- Stay away from power lines, substations and pad-mounted transformers. If a downed power line is found - stay away and tell an adult immediately. Even if the line is not sparking or humming, fallen lines can kill if touched. The line may also energize the nearby ground and water creating a greater hazard.

Recognizing Outdoor Electrical Danger

- Many electrical dangers do not have physical warning signs, but quick wit and keen eyes will help to keep everyone safer.
- Electricity will travel through the string of a kite or a balloon caught in an overhead power line potentially causing shock or fire.
- Metallic balloons are highly conductive. Keep these toys indoors.

Outdoor Recreation Toys and Tools

Kites	Always fly kites away from overhead lines. Always use non-metal string or cord to fly kites. Never use metal in the construction of a kite.
Model airplanes	Always fly model airplanes away from overhead lines. Always use non-metal string or cord to fly model airplanes.
Fishing poles	Be aware of power lines around.
Parade flag poles	Be aware of overhead power lines.

Sailboat masts	Be aware of upcoming power lines. Be cautious around docks.
Hang gliders	Be aware of surrounding and upcoming power lines.
Parachutes	Be aware of surroundings and upcoming power lines.

Keep the *Electrical Safety Eye* on grown-ups while they are outside

Realize that a tree trimmer, a metal ladder, or other object can extend past a grown-up's reach and too close to overhead power lines.

Do It Yourself Dangers

Keep an eye on grown-ups:

- Using a ladder
- Trimming a tree
- Cleaning a pool
- Digging in the yard
- Carrying long tools or pipes
- Working on a roof

Remind grown-ups if something seems unsafe.

Stay clear of their work area.

Lightning

Lightning will strike. However, people may be protected from most of lightning's effects by using common sense during storms.

Lightning kills nearly 100 people each year in the United States. It injures hundreds more. It may travel as far as 40 miles. Each second of the day it falls somewhere on earth. Lightning can generate temperatures as high as 50,000 degrees Celsius. It can, and does strike in the same place twice.

A direct lightning strike to a human generally results in severe burns, a heart attack or no breathing. Prompt resuscitation may result in revival, but there may be other critical injuries.

Lightning zigzags from the clouds to the ground using the closest conductor. Generally this conductor will be the tallest object around. The word *tallest*, however, is a relative term. A tall object could be the Sears Tower, a shed out on the farm, or a child standing on the soccer field. Lightning may strike any object in its path and may reach those nearby a strike through the ground or the water.

Conducted current from a lightning flash may range from a minor or a tingling shock to a massive current diverted from a nearby power pole. When lightning is

nearby, find shelter immediately. If unable to find a building or home for safety, follow the guidelines suggested by the Lightning Protection Institute.

If caught outdoors unprotected...

- Get in a hard-topped car.
- Spread out and away from others - Don't stand in a crowd of people.
- Move away from metal objects including bikes, fencing and machinery.
- Get out of and move away from pools, lakes, and other water bodies.
- Move away from trees.
- Seek areas of land that are lower than the surrounding landscape.
- If a tingling sensation is felt, or the hair stands on end, lightning may be about to strike. Immediately crouch low to the ground on the balls of the feet and cover the ears. Do not lie down, or place your hands on the ground.
- Return to activities no sooner than 30 minutes after the last sound of thunder or flash of lightning.

For more information on lightning safety, visit
<http://www.lightning.org/awareness.htm>

How is it that birds...

Question: How can birds sit on power lines and not get shocked?

Answer: Electricity always seeks a way to the ground. Birds on wires do not represent part of a path to the ground so the Electricity flows right past their feet.

What to do if...

Electrical fires

- Get out.
- Notify 9-1-1 or tell an adult. Tell the dispatcher it is an electrical fire.
- Stay away.

Electrical shock

- Do not touch anyone or thing you think might have been electrically shocked. S/he may still be in contact with the electricity.
- Call 9-1-1 or tell an adult. Tell the dispatcher this involves electricity.
- Keep other people away from the continued danger.
- Understand that electrical shock may cause internal injuries. The person needs to be seen by a doctor, even if you don't see any burn marks.

Downed power lines

- Move quickly away even if you do not see sparks.
- Call 9-1-1
- Stay away from anything that might touch the wire: a fence, a tree, a building, a car.
- Wait for help.

Power line touching the car you are in

- Stay in the car.
- If people move toward the vehicle, motion for them to stay away. Have someone call 9-1-1 for help.
- Stay in the car until help arrives.

Power outages

Build a kit to help be more comfortable in the event of a power outage.

Basics might include:

- Flashlights for each member of the household
- Radio, battery powered

- Batteries for each item
- Canned food and can opener
- Prepackaged foods
- Bottled water for drinking and cleaning
- First aid kit
- Essential medications
- Toilet items
- Books and games to pass the time