Electrical Safety World

EXPLORE...
Could You Survive Without Energy?

DISCOVER...
How Electricity Happens

INVESTIGATE...
Fascinating Electrical Experiments

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Can You Survive Without Using Energy?

You need energy to work or play, and you get your energy from food. Appliances like refrigerators, ovens, heaters, TVs, computers, and air conditioners need energy to work, too, but they get their energy from sources like electricity or natural gas.

Energy Use Chart

List all the ways you've used energy today. Some sources of energy you might have used are electricity, natural gas, fuel oil, charcoal, wood, propane, gasoline, or solar. An example is done for you.

What I Did	Appliance/Equipment I Used	Energy Source
Read a book	lightbulb	electricity

What Do You Think?

Could you survive for a day without using any energy sources? Write or explain how you would keep warm or cool, what you would eat, and what you would do for transportation. Bonus: What would you do for fun?

Q. What did the baby light bulb say to the mommy light bulb?

A. I love you watts and watts!

Electrified Words

I	N	S	U	L	A	T	O	R	E	E
T	N	E	R	R	U	C	D	N	O	L
S	A	G	L	A	R	U	T	A	N	E
X	Q	W	Q	C	E	K	A	A	V	C
Y	C	O	N	D	U	C	T	O	R	T
G	R	I	B	M	A	P	O	S	M	R
R	H	S	R	J	A	U	M	E	V	O
E	Y	U	T	C	I	W	S	J	O	N
N	H	L	R	V	U	G	L	Z	L	D
E	L	E	C	T	R	I	C	I	T	Y
P	M	B	O	K	W	A	T	T	S	F
N	A	T	P	A	C	R	E	M	L	O

Here are some electricity vocabulary words. See if you can find them in the puzzle.

ATOMS: Tiny particles that make up everything around us. Atoms are so small that 12 trillion of them can fit in a grain of sand.

CIRCUIT: A closed path or loop that is needed for electricity to flow. Electricity will not flow if a circuit is open.

CONDUCTOR: A material that allows electricity to flow through it easily. Water and metal are good conductors. So is your body!

CURRENT: The flow of electrical charge, measured in amperage ("amps" for short). The amperage in an electric circuit is like the amount of water that comes out when you turn on a faucet.

ELECTRICITY: A type of energy carried by the movement of electrons.

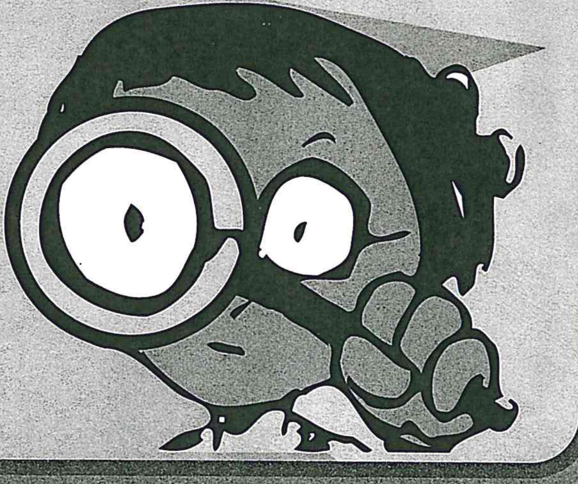
ELECTRON: A particle that travels around the nucleus at the center of an atom.

ENERGY: A property of many substances that is associated with heat, light, electricity, mechanical motion, and sound.

INSULATOR: A material that does not allow electricity to flow through it easily. Special rubber and special glass are used as insulators.

VOLTS: Short for "voltage," a measure of the force with which electricity flows. The voltage in an electric circuit is like the pressure that pushes water out when you turn on a faucet.

WATTS: A measure of the work that electricity does. Watts = Amps x Volts.



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How Elect

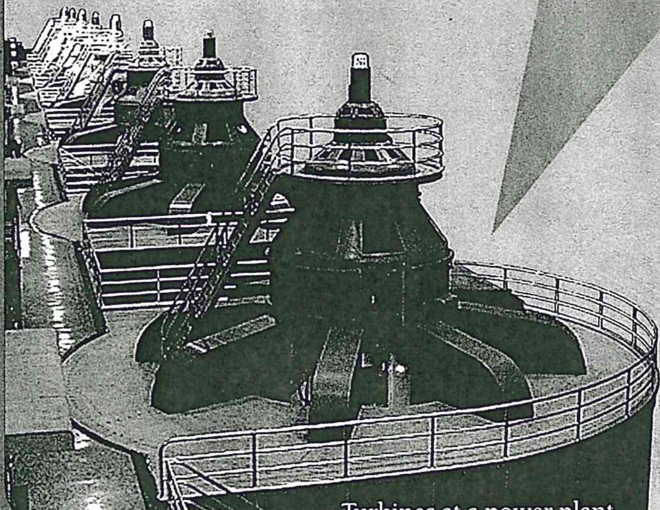
Electricity starts with atoms, the tiny particles that make up everything around us. Even tinier particles called electrons orbit the center of atoms. When electrons move from atom to atom through a wire, electricity results.

Electricity is typically produced at power plants where various energy sources are used to turn turbines. The turbines turn electromagnets that are surrounded by heavy coils of copper wire. The moving magnets cause the electrons in the copper wire to move from atom to atom, generating electricity.

Which Are Renewable?

RENEWABLE FUELS can be replenished in a short period of time, so they will never be all used up. NON-RENEWABLE FUELS can someday be used up.

Here are some different fuels used to generate electricity. Put an X in the correct circle to show whether each one is renewable or non-renewable. On a separate sheet of paper, explain why you think so.



Turbines at a power plant.

Fossil Fuels

Fossil fuels (coal, oil, and natural gas) were formed from the fossilized remains of creatures that lived long ago. Most electricity used in the world is generated from power plants that burn fossil fuels to heat water and make steam. The highly pressurized steam is directed at turbine blades to make them spin.

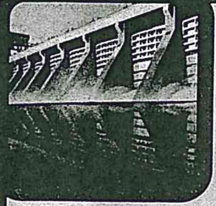
○ renewable ○ non-renewable

Nuclear Power

Nuclear power plants use heat released from splitting atoms to convert water into the steam that turns turbines. They rely on uranium, a type of metal that is mined from the ground.

○ renewable ○ non-renewable

...icity Happens



Hydropower
Hydroelectric plants use the power of falling water to generate electricity. Water that is stored behind a dam is released and directed to flow against turbine blades, making them turn.

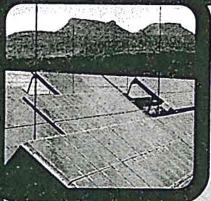
○ renewable ○ non-renewable

Biomass
Biomass includes wood chips and bark left over from lumber production, farming and food wastes, and garbage. Biomass can be burned to heat water, producing steam that turns a turbine. It can also be converted into a gas, which can be burned to do the same thing.

○ renewable ○ non-renewable

Geothermal Energy
Steam (or hot water that has been converted to steam) from deep inside the Earth is piped to the surface, where it is used to turn turbines.

○ renewable ○ non-renewable



Solar Energy
Solar energy is generated without a turbine. Special panels of photovoltaic cells capture light from the sun and convert it directly into electricity, which is stored in a battery.

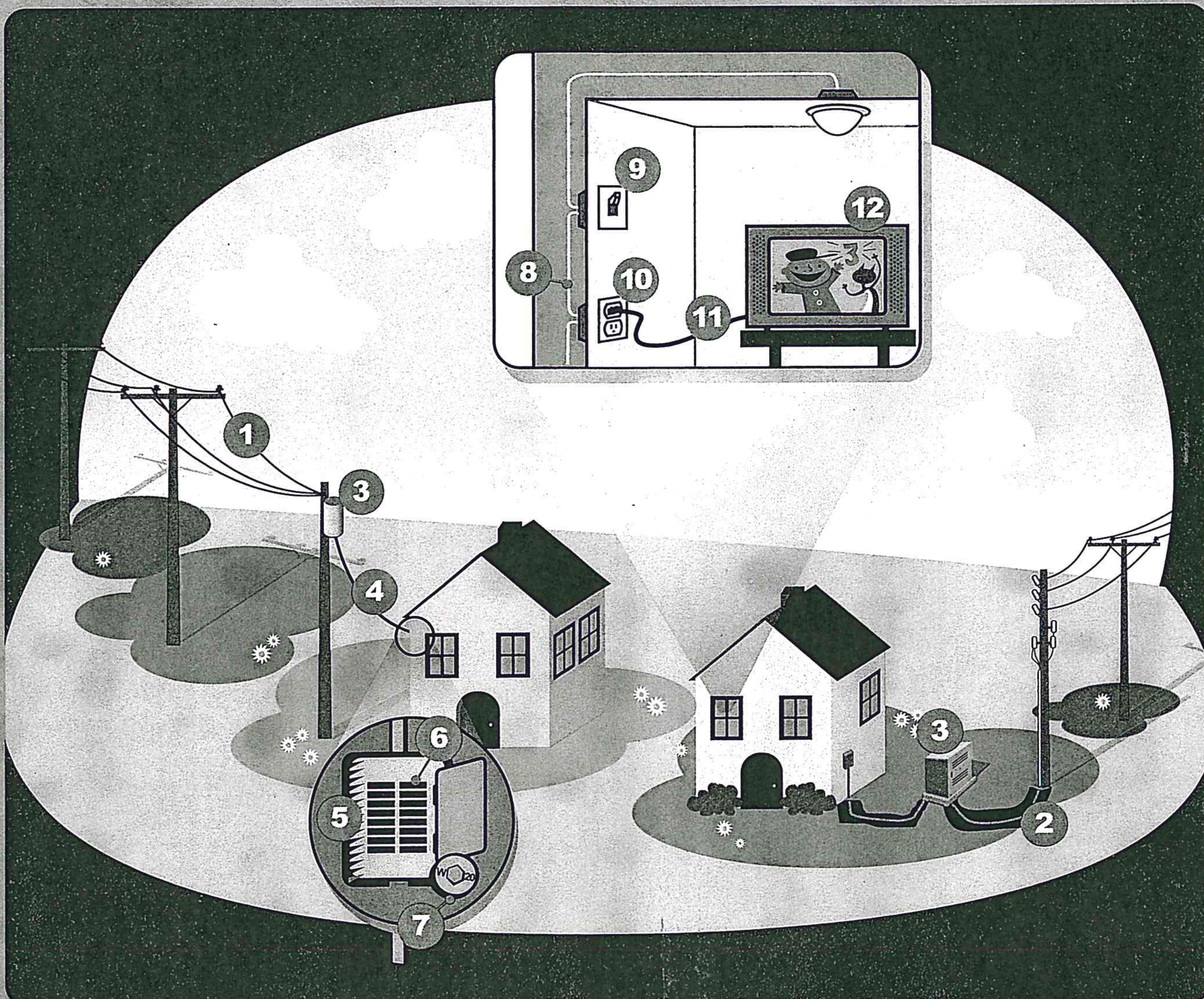
○ renewable ○ non-renewable

Wind Power
The force of the wind is used to spin many small turbines. Most wind power is produced at wind farms, which are large groups of turbines in very windy locations.

○ renewable ○ non-renewable

Fuel Cells
Fuel cells produce electricity through a chemical reaction. Some types of fuel cells can be used at power plants. Others can be used to run cars or appliances.

○ renewable ○ non-renewable



Go with the Flow

Electricity travels in a closed path called a circuit. When you switch on an appliance, you complete a circuit for electricity. Here is how it works:

Electricity flows from overhead power lines, or underground power lines, through a transformer where the voltage is reduced. From the transformer, electricity travels through service wires to your home's electrical panel. This panel has circuit breakers or fuses that turn off the electricity if there is an electrical problem. From the panel it flows through your home wiring to a switch or an outlet, and then through a power cord to the appliance where it does its job.

To complete the return part of the circuit, electricity flows back through a different wire in the power cord to your home wiring, and back through the service wires to the transformer and the power lines.

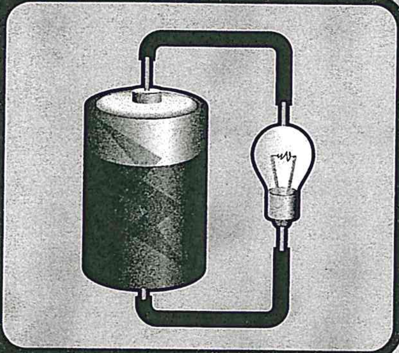
Use the red words to label the illustration.

Which Bulbs Will Light?

Which of these circuits are closed paths that will allow electricity to travel in a loop and make the bulb light? Show whether each circuit is closed or open by putting an "X" in the correct circle. Write why you think so.

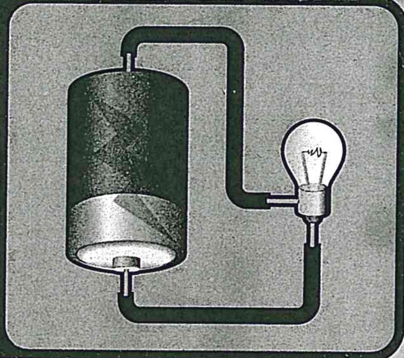
○ Open
○ Closed

Why?



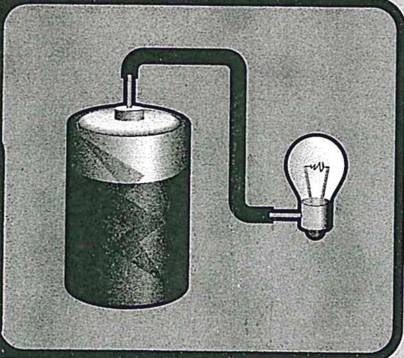
○ Open
○ Closed

Why?



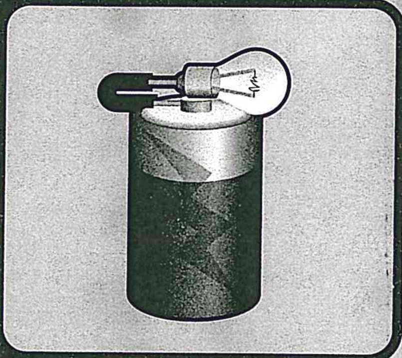
○ Open
○ Closed

Why?



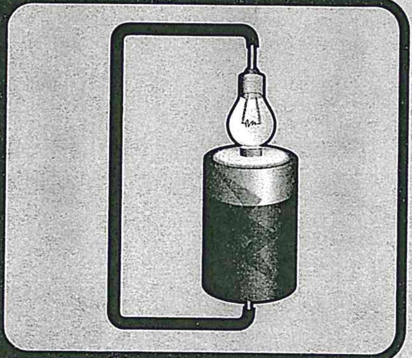
○ Open
○ Closed

Why?



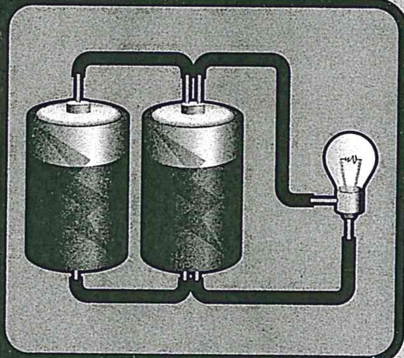
○ Open
○ Closed

Why?



○ Open
○ Closed

Why?



Did You Guess Right?

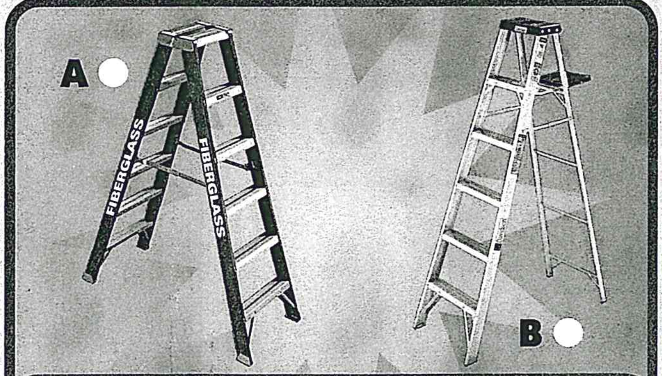
Get two D batteries, a flashlight bulb, and four pieces of insulated copper wire stripped at the ends. Set up the materials as they are shown in the illustrations. (Hint: use tape to hold your circuit together.) Were you right about which circuits were closed and which were open?

Conductors & Insulators

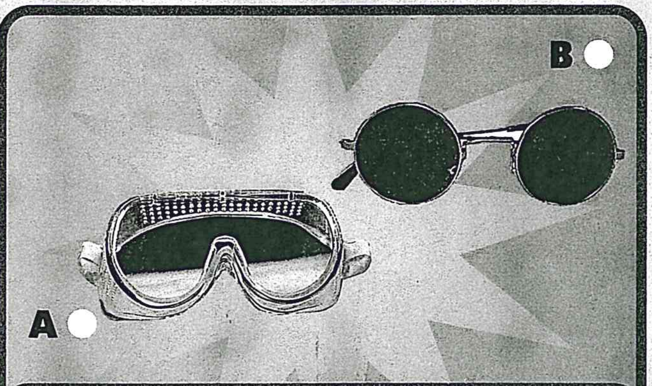
CONDUCTORS are materials that allow electricity to flow easily through them. Water, metal, and your body are good conductors. So if you contact electricity from a power line, power cord, or appliance, you risk serious injury or electrocution (fatal shock).

INSULATORS are materials that do not allow electricity to flow easily through them. Specially tested rubber and glass are insulators. People who work around electricity use tools and equipment made of insulators to help prevent shock in case they contact electricity.

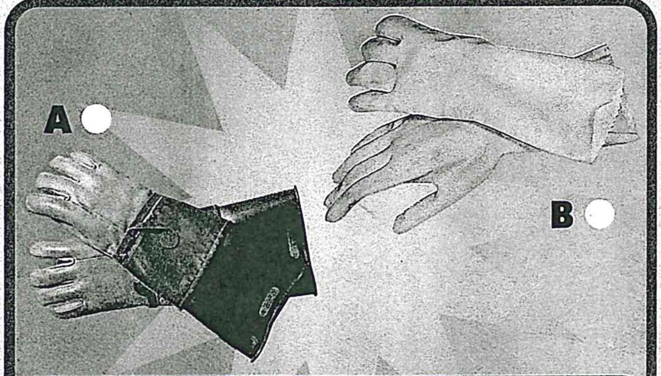
Which object in each pair is more likely to be used by people who work around power lines?



Why?



Why?



Why?

Q. Why did the electric guitar quit the band?

A. It found a better CONDUCTOR somewhere else!

What Do You Think?

Does a big metal object (like a ladder) conduct electricity differently than a small metal object (like a scissors)? Explain your prediction. If you have a battery/wire/bulb circuit, use it to test some big and little metal objects to see if your prediction was correct.

Struck by Lightning

Carissa from Petaluma, California

I was struck by lightning when I was 15. It was raining. I was in my high school parking lot about to get into my Mom's car. I had just closed my umbrella. All of a sudden I saw a bright light and I felt lightning go through my body. I got extremely warm and started shaking. My Mom saw the whole thing. She said I just lit up.

The umbrella conducted the lightning into my arm. The metal tip at the top of the umbrella got indented and burnt. My arm got tingly, sore, and weak. I had some nerve damage in my arm and I needed physical therapy to get it working right again.

I consider myself really lucky to be alive and okay. If it's storming I don't go out in the thunder and lightning anymore. I don't want it to ever happen again.

Lightning Can Hurt or Kill You

Plan ahead so you don't get caught outside during a storm. If you see lightning or hear thunder, go indoors immediately. Lightning can travel through phone and electrical wiring and water pipes, so stay away from bathtubs, sinks, phones, and anything that uses electricity—like TVs, computers, or video games.

IF YOU CAN'T GET INDOORS:

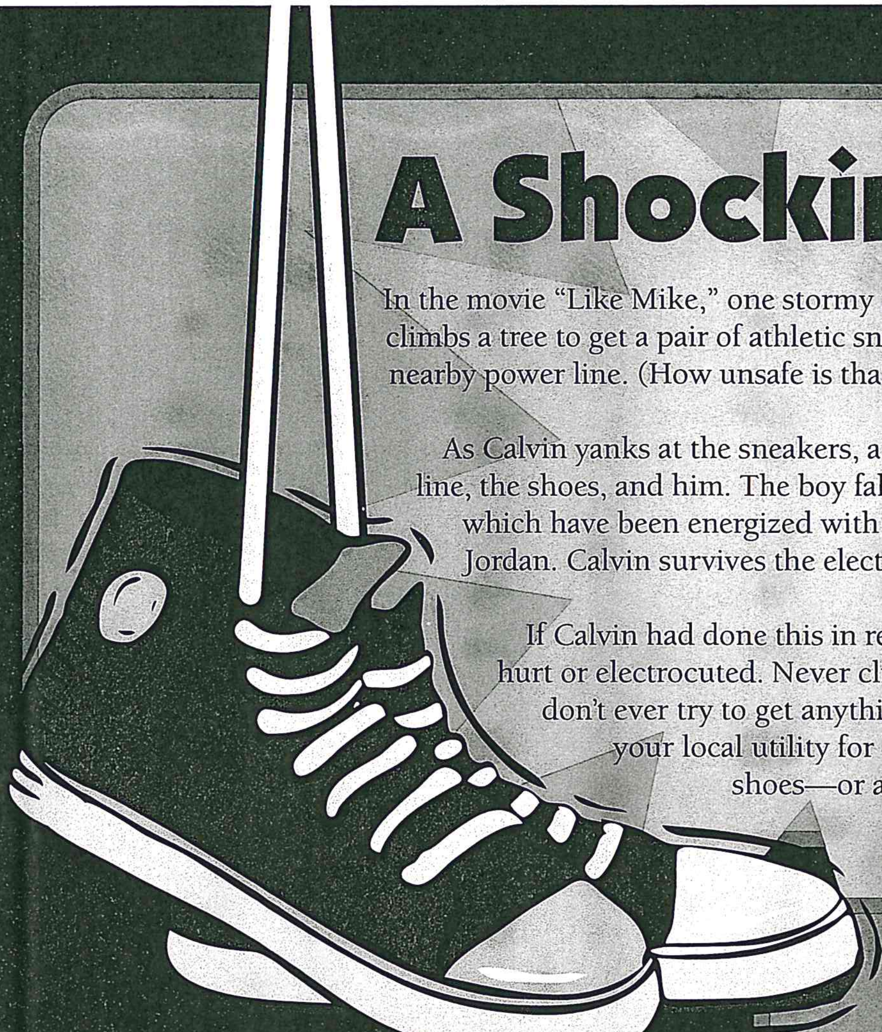
- You'll be safer in a hardtop car with the windows up. Keep out of convertibles, golf carts, tractors, or other open vehicles.

- Stay away from trees, tall objects, and anything metal. Lightning is drawn to them.
- Stay away from rivers, lakes, and swimming pools. Lightning likes water.
- Avoid wide-open areas, including sports fields, golf courses, and parks.
- If you are caught in the open, squat or kneel. Bend forward with your hands on your knees. Do not lie down.

What Do You Think?

The electricity in most homes is 120 volts. A lightning bolt can carry up to 30 million volts! If you could harness the electricity from one lightning bolt, how many homes would it light up?

A Shocking Scene



In the movie "Like Mike," one stormy night young Calvin Cambridge climbs a tree to get a pair of athletic sneakers that are hanging from a nearby power line. (How unsafe is that?!)

As Calvin yanks at the sneakers, a bolt of lightning strikes the power line, the shoes, and him. The boy falls to the ground with the sneakers, which have been energized with the athletic powers of Michael Jordan. Calvin survives the electrical shock, unhurt. (That's bogus!)

If Calvin had done this in real life, he would have been badly hurt or electrocuted. Never climb trees near power lines, and don't ever try to get anything hanging from a power line! Call your local utility for help instead. And please don't throw shoes—or anything else—at power lines.

Grounded!

Electricity is always looking for the easiest path to the ground. Electricity will stay in power lines unless someone—or something—gives it a path to the ground. If you touch a power line while standing on the ground or on something resting on the ground, like a ladder or a tree, you could give electricity a path to the ground. Anyone who touches a power line is in danger of being hurt or killed.

Have you ever seen a "shocking" scene?

Have you ever seen a movie, video game, TV commercial, or book that shows someone breaking electrical safety rules? Write about it or describe it to your class. Include what the character did wrong, and what could happen if a real person were to do the same thing.

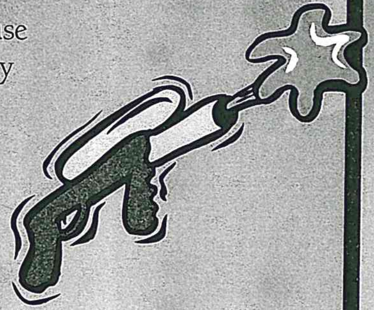
What Do You Think?

Metal conducts electricity. So why doesn't electricity travel down metal utility poles?

Follow These Outdoor Safety Tips:

If you fly kites or climb trees...

Do it far from power lines. Kites in power lines can cause outages or fires. Climbing trees near power lines is risky business—trees have lots of water in them and can conduct electricity.



If you play with high-power water squirters...

Keep them away from power lines. If you shoot water at a power line, electricity can travel down the stream of water, right back to you!

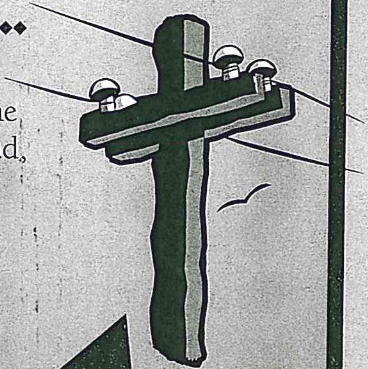
If someone you know is planning a digging project...

Make sure they call the underground utility locator service at 811 first. Underground utilities are everywhere, even in your yard. Digging into them can be hazardous.

811
Know what's **below.**
Call before you dig.

If you see a fallen power line...

Stay far away. Even if the line is not sparking or humming, it could be carrying electricity. Don't touch the line or anything it is touching, like a tree or fence. Instead, call 911 to report the fallen line.



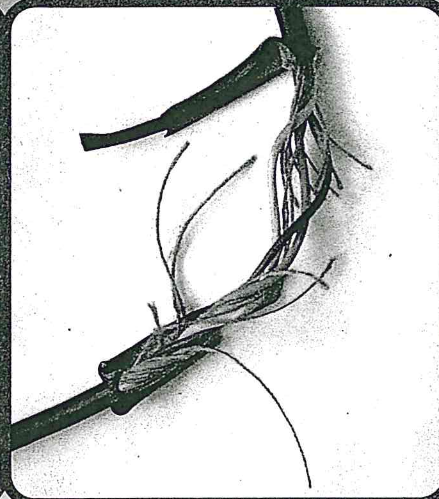
If you're in a car with a power line on or near it...

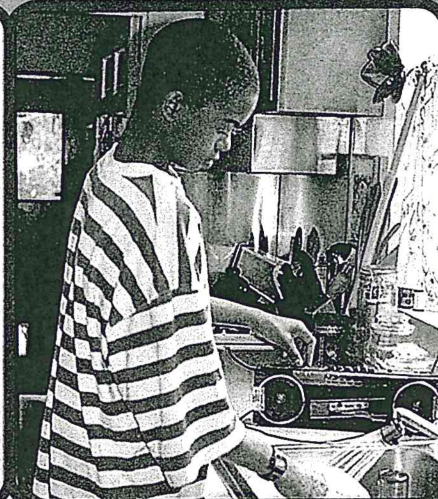
- Warn people to stay away; ask them to call for he
- Stay there until rescue workers arrive. You are safer inside the car because the rubber tires help prevent electricity from going to the ground.
- If you must leave because of fire or other danger, do not step out of the car. If you touch the car and the ground at the same time, you will be shocked. Instead, jump clear, land with your feet together, and shuffle away keeping both feet on the ground.

Get Creative!

Pick one of these power line safety tips. Make a poster, rap song, mini-book, or oral presentation to explain this tip and what could happen if people don't follow it.

Indoor Electrical Safety





1. Unscramble these sentences to learn some indoor electrical safety tips:

- toaster the first unplug ________ ________ ____ ________
- frayed a use don't cord _______ _____ _ __________ _______
- water near radio a use battery-powered ____ _ ______ - _______ _______ _____ ________

2. Circle the conductors in each picture.

3. On a separate sheet of paper, explain why each of these situations is dangerous. What terrible thing could happen next?

Use this space to write some other indoor electrical safety tips that you know, and why it's important to follow them. The first one is done for you.

Don't overload electrical outlets. Overloaded outlets are a fire hazard.

Everyone Wants to Know...

These frequently asked questions about electricity have been overheard in classrooms around the country. See if you can figure out the answers using the Internet and the library; then check the answer key to get the scoop.

1. Why can you sometimes see a spark if you can't see electricity?
2. Why didn't Ben Franklin get killed when he tied a metal key to a kite string and flew the kite in a thunderstorm?
3. When a circuit is open, do electrons go backwards, or do they just stop?
4. Why does electricity try to get to the ground, and what does it do when it gets there?
5. Why can birds stand on power lines and not get shocked?

Answers

1. 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. The spark is a flame that happens when the electricity travels through the air and burns up oxygen particles.

2. 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 been struck by lightning, Franklin would have been killed!

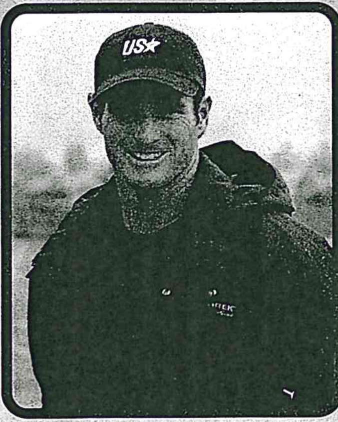
3. Neither! In the wires of an electrical circuit, the electrons are always jiggling around. When a circuit is closed to run an appliance or a light bulb, the electrons jiggle a lot and travel through the wire. When the circuit is open, all the electrons just jiggle where they are—kind of like running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

4. 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.

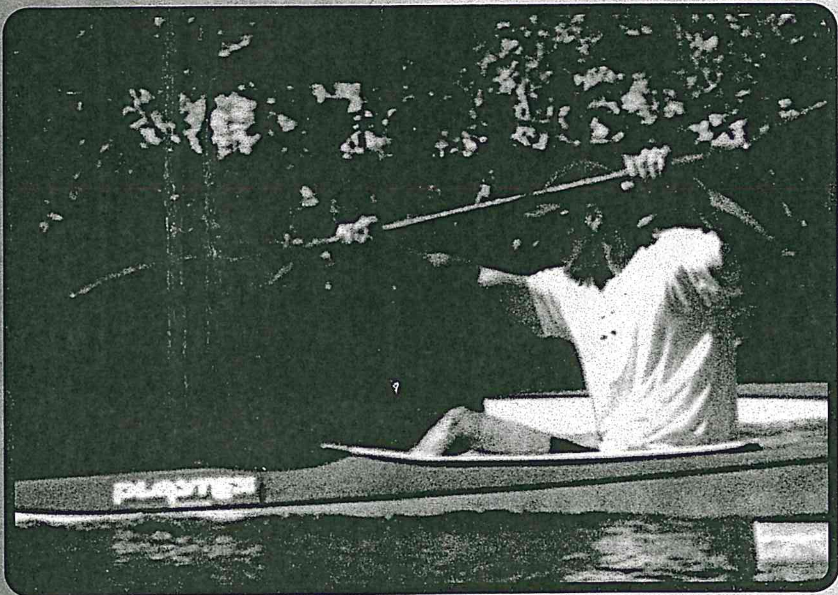
5. Most birds on power lines don't get shocked because they don't give electricity a path to the ground. But if a bird with large wings touches a power line and a power pole at the same time, it provides a path to the ground and could be shocked. Birds can also be shocked if their wings contact two power lines at the same time, creating a circuit.

Olympic Kayaker's Shocking Tale

In November 1986, while using a jackhammer to break up some concrete, Cliff Meidl contacted a buried power line. Electricity traveled through Cliff's body, burning him as it went. It exploded out Cliff's head, shoulder, and foot, taking two toes with it.



Cliff's heart stopped immediately, but a rescue worker revived him. His heart stopped twice more in the ambulance on the way to the hospital, but still Cliff survived.



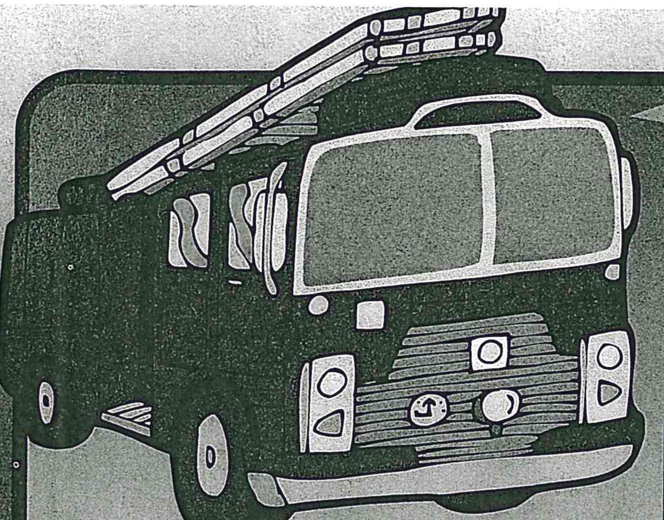
"Part of each knee joint was burned away," says Cliff. "I had such bad injuries the doctors said they would have to amputate my legs."

Fortunately, one doctor was able to save his legs with a special operation. Cliff left the hospital in a wheelchair. As part of his rehabilitation Cliff began to canoe and kayak, and he became one of the best kayakers in the world. Cliff competed at the Olympic Games in Atlanta, Georgia, in 1996 and Sydney, Australia in 2000.

Cliff learned from his experience that knowing how to be safe around electricity can help people avoid electrical injuries like his. "Just like winning at a sport has a lot to do with training and planning, avoiding electrical injuries has a lot to do with preparing ahead of time," Cliff explains. "I learned that the hard way."

Call Before You Dig! Cliff's injuries could have been prevented if someone had called the underground utility locator service at 811 before he started digging. This service marks the location of underground power lines and other utilities so people can dig a safe distance away from them. Remember: if you or your parents plan to dig (even just planting a tree) call 811 first!

811®
Know what's **below.**
Call before you dig.



In Case of Emergency!

Electrical Fire!

NEVER use water on an electrical fire. Because water conducts electricity, throwing water on an electrical fire can cause the fire to get larger.

1. Tell an adult to turn off the main power to the house.
2. If the fire can be put out safely, tell an adult to use a proper chemical fire extinguisher. If the fire cannot be put out safely, leave the house and take everyone with you.
3. Call 911 or your emergency number and tell them it is an electrical fire.

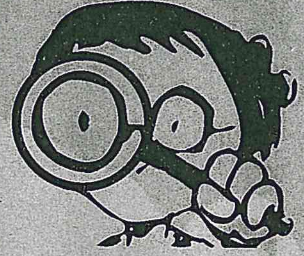
Take it Further

Find out about someone who has survived an electrical shock. Use the library, Internet, or local newspaper, or interview an EMT or emergency room worker at the local hospital. Find out how the shock happened, and how the person was affected by it. Also find out how the incident could have been prevented. Present your research in a written or oral report.

Electrical Shock!

If someone has been shocked, there's a chance they may still be in contact with the source of the electricity. Do NOT touch the person or anything he or she is touching. You could become part of electricity's path and be shocked or even killed.

1. Tell an adult to turn off the main power to the house.
2. Call for help (usually 911). Tell them it is an electrical accident.
3. When the victim is not in contact with the source of electricity and you're sure there is no danger, tell an adult to give first aid for electrical injury. This may include CPR.
4. Don't touch burns, break blisters, or remove burned clothing. Electrical shock may cause burns inside the body, so be sure the person is taken to a doctor.



HOME SAFETY INSPECTION

TAKE THIS BOOKLET HOME AND DO THIS ELECTRICAL SAFETY INSPECTION WITH AN ADULT. IF YOU FIND ANY HAZARDS, CHECK "NEEDS FIXING" AND ASK AN ADULT TO HAVE THEM FIXED.

LOOK FOR:

1. Overloaded outlets.
   ❍ None ❍ Needs fixing ❍ Fixed

2. Worn or frayed power cords.
   ❍ None ❍ Needs fixing ❍ Fixed

3. Power cords under rugs or furniture legs.
   ❍ None ❍ Needs fixing ❍ Fixed

4. Electric heaters close to anything that can burn.
   ❍ None ❍ Needs fixing ❍ Fixed

5. People digging without having called 811 first.
   ❍ None ❍ Needs fixing ❍ Fixed

6. Plug-in radios, CD players, or other electric appliances used near bathtubs, hot tubs, or pools.
   ❍ None ❍ Needs fixing ❍ Fixed