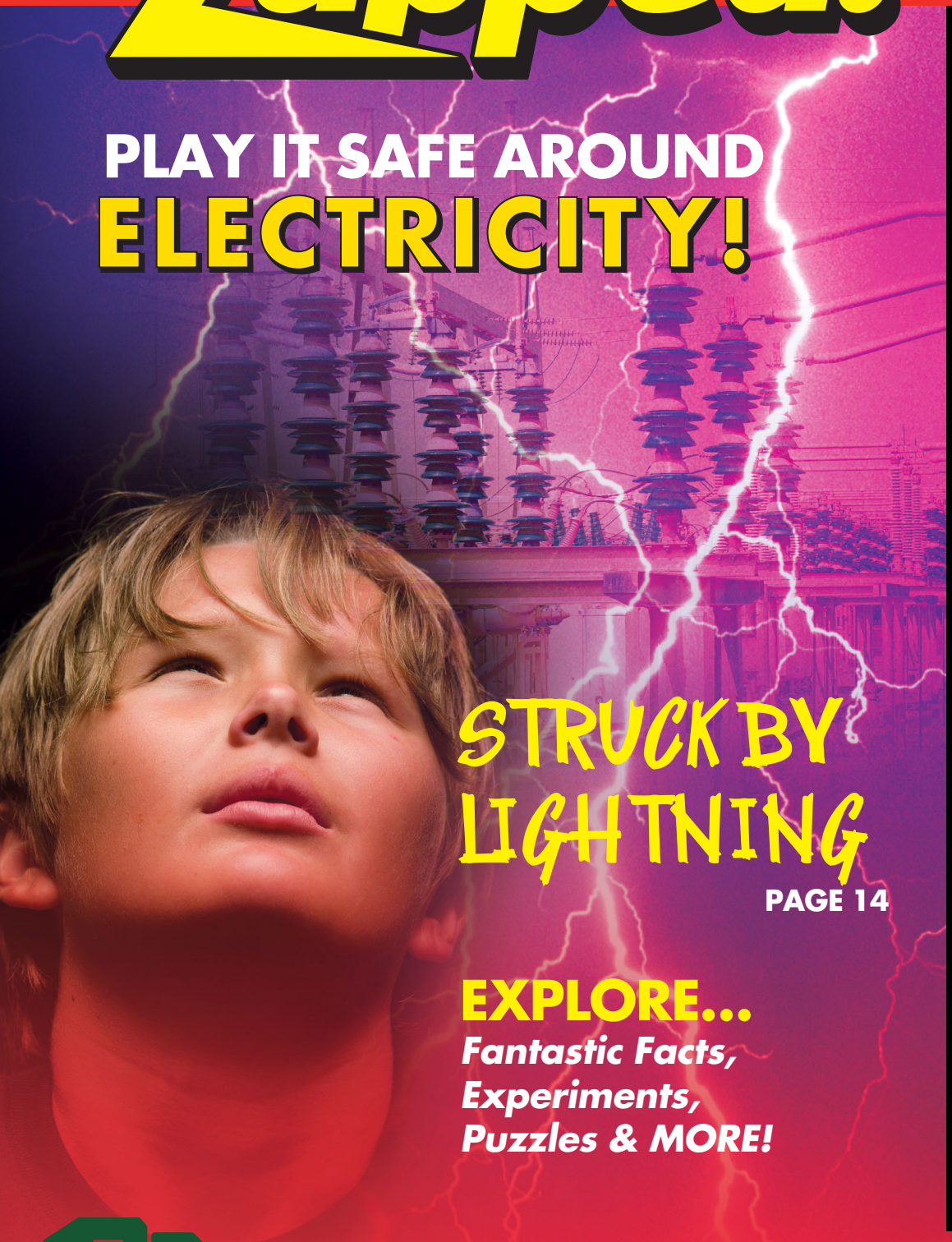
Don't Get Zapped!

PLAY IT SAFE AROUND ELECTRICITY!



STRUCK BY LIGHTNING

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EXPLORE...

Fantastic Facts, Experiments, Puzzles & MORE!

KEEP THE BEAT

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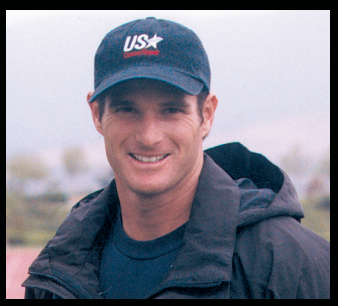


OLYMPIC COMPETITOR'S SHOCKING STORY

PAGE 4

ELECTRIC ART

PAGE 7

santee cooper®

What's Inside

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.

I learned that the hard way. When I was 20 I contacted an underground power line by mistake, and was seriously injured. You can read my story on page 4.

You might think an electrical injury won't happen to you, but it can! Each year electrical burns or electrical shock injure more than 4,000 kids and kill about 25 kids under age 15. Take a lesson from me—take the time to learn how electricity works and how to be safe around it. Read Don't Get Zapped!

Cliff Meidl
Olympic Kayaker

Managing Editor
Wendy "What If?" Ellyn

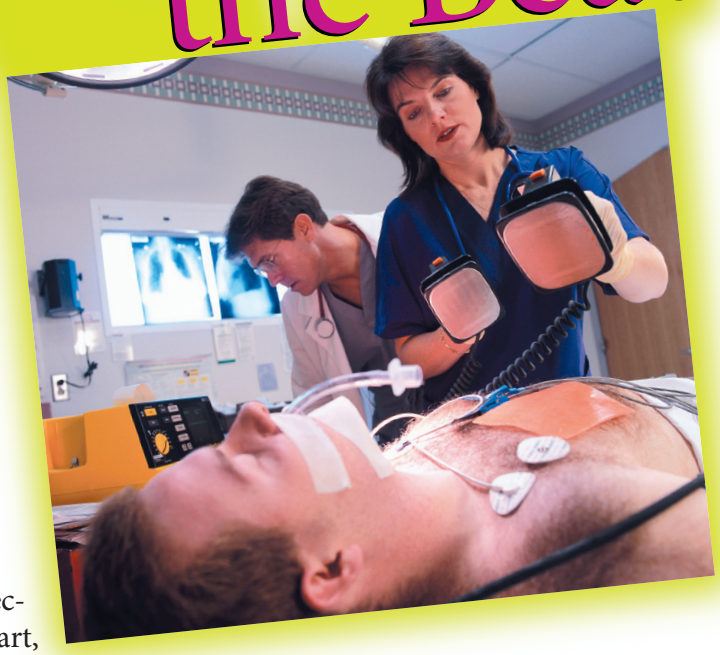
Editor
Carol "Better Safe Than Sorry" Ewart

Art Director
Ken "Grounded Outlet" Feisel

Keeping the Beat

Electric shock can seriously injure or kill, but sometimes it can actually save a life

By Andrew Hidas



You've seen the scene on TV or in the movies. Doctors and nurses in an emergency room crowd around a patient whose heart has stopped. One doctor picks up a metal paddle in each hand and yells: "Clear!" Everybody steps back.

The doctor places the two paddles against the patient's bare chest and zaps him or her with an electrical charge. If the shock restarts the patient's heart, the camera usually shows a TV monitor with a bright line like a row of mountain peaks. Each peak represents a heartbeat.

How can an electrical shock help save a life? Your heart is an amazing muscle. All day, every day, while you're brushing your teeth or riding your bike, billions of tiny cells in your heart work together to pump blood and oxygen through your body. Inside each heart cell, tiny electrical currents fire in rhythm with the other heart cells.

Sometimes, heart cells can't keep the same rhythm because of disease or injury. Clumps of heart cells try to make the heart pump at different speeds. Overwhelmed with different rhythms, the heart suffers an attack. It stops pumping blood. Death can occur within minutes unless the doctors restart the heart by shocking it with the paddles. They are part of a machine called a defibrillator (dee-fib-rill-a-ter).

The 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!

The defibrillator delivers a very small shock at first. If the patient's heart does not respond, doctors zap again, each time with a little more power. The biggest zap the defibrillator can deliver is about 360 joules. That's enough energy to light about seven 50-watt light bulbs for one second.

So why does the doctor shout "clear" before shocking the patient? Anyone who is touching the patient or the bed would become part of electricity's path. They would be shocked, too. Most of the time, the shock would hurt, but it wouldn't cause injury because the defibrillator's charge is small and does not last long. Sometimes, though, the shock might make a normal heart beat irregularly, and that could be dangerous. ■

DO THE SAFE THING

The electricity in a defibrillator is carefully measured to help people. But if you contact the electricity in an appliance, electrical cord, or power line, you will be

Think About It! What are 10 ways electricity helps people every day?

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OLYMPIC COMPETITOR'S Shocking St

In November 1986, while using a jackhammer to break up a concrete slab, Cliff Meidl received a severe electric shock. He had not known that a power line carrying thousands of volts of electricity was buried in the concrete.

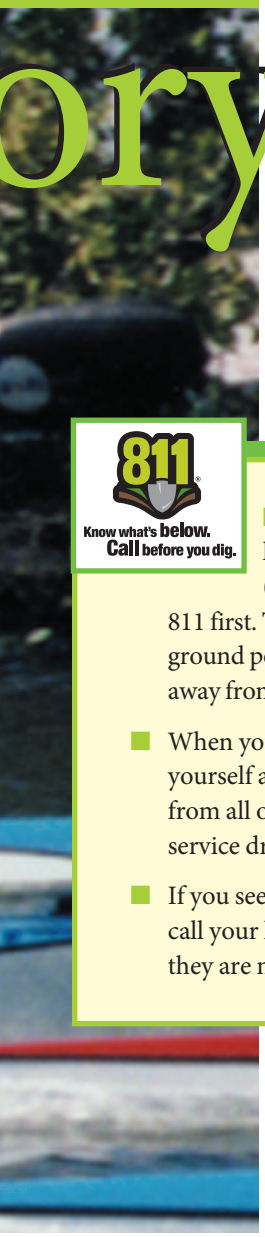
When the jackhammer contacted the power line, the electricity traveled instantly through Cliff's whole body, burning him as it went. It exploded out the back of Cliff's head, his shoulder, and his foot, taking two toes with it.

Cliff's heart stopped immediately, but a firefighter did CPR (cardiopulmonary resuscitation) and revived him. His heart stopped twice more in the ambulance on the way to the hospital, but still Cliff survived.

"One-third of each knee joint was burned away," says Cliff. "I had such extensive injuries that the doctors said they would have to amputate my legs."

Zapped! SCIENCE

Electricity always takes the easiest path to the ground, and will travel there through anything that is a conductor. Conductors are materials that allow electricity to flow easily through them, such as metal, water, and the human body. So if you contact electricity while you are touching the ground (or something resting on the ground, like a ladder), your body can become electricity's path. You will be shocked or killed.



ory

by Carol Ewart

DO THE SAFE THING

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

- If you or someone you know plans to dig or move earth in any way (even just to plant a tree), make sure to call 811 first. This service will locate and mark underground power lines so people can dig a safe distance away from them.
- When you work or play outdoors, be sure to keep yourself and your equipment at least 10 feet away from all overhead power lines. That includes the service drops that go from power poles to buildings.
- If you see a downed power line, stay far away and call your local electric utility immediately. Even if they are not sparking or humming, downed lines can

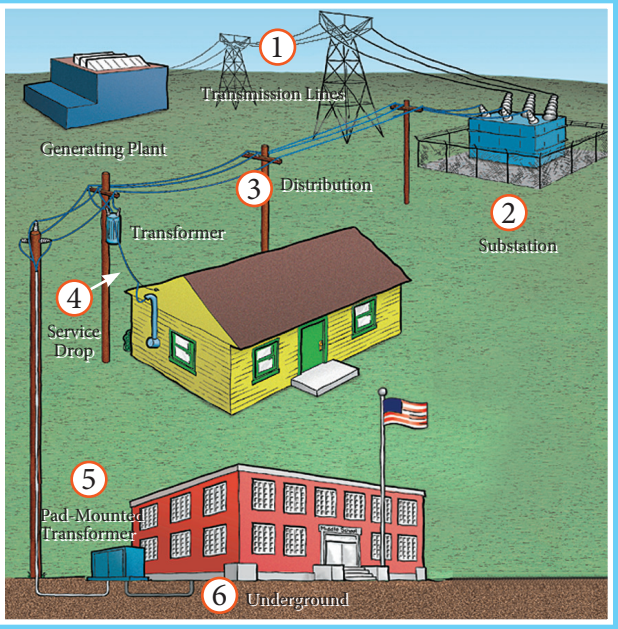
Fortunately, one doctor was able to save his legs with a special operation. Cliff left the hospital in a wheelchair and began the long process of rehabilitation, which included many, many surgeries.

Before his accident, Cliff had been a runner. "I was heartbroken because they said I wouldn't ever walk or run again," he says. But Cliff didn't give up. He worked hard to build his strength and eventually was able to walk, though he has to wear heavy braces on his legs.

As part of his rehabilitation, Cliff began to canoe and kayak. Because of his hard work and determination, he became one of the best kayakers in the world and was chosen to compete at the Olympic Games in Atlanta, Georgia in 1996 and Sydney, Australia in 2000.

What Do You Know About Power Line Safety?

In this picture, electricity travels through power lines from a generating plant to a substation where the voltage (the force of electricity) is decreased. Then it goes through distribution lines to buildings where we use it for lights, appliances, motors, and equipment.



Choose one of the numbered locations above. Work with a team or partner to think of how a person could be hurt by contacting electricity at this location, and at least one way to stay safe. Write your ideas below.

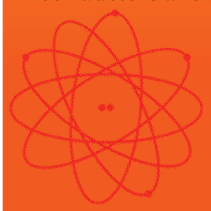
"I don't think I would have had the will and determination to make it to the Olympics without going through an experience like this," Cliff says. "But I have enormous physical limitations. The damage is done, and there's no coming back from that." ■

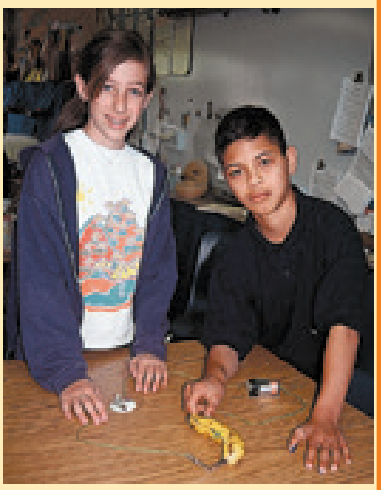
Think About It! What could have been done to prevent Cliff's electric shock incident?

Experiment with Conductors and Insulators

Zapped! SCIENCE

Electricity starts with the atom, the basic unit of all matter. Electrons orbit around the atom's center, or nucleus. When electricity contacts an object, it causes the electrons in the atoms of that object to move. The electrons don't move very far, just to the next atom. Materials that are conductors allow electricity to flow easily through them because the electrons in the atoms of conductors move easily. Materials that are insulators resist the flow of electricity because the electrons in the atoms of insulators do not move easily.





1. Get a 1.2-volt light bulb, a matching light bulb base, a D-cell battery, three pieces of copper wire with the insulation stripped off the ends, and a banana. Set up the equipment as shown.
2. With a partner, gather a variety of objects to test. (Will a lemon slice conduct electricity? Will a paper clip?)
3. List your items below. Put a "C" by the ones you predict will be the best conductors, and an "I" by those you think will be insulators.
4. Substitute your objects, one at a time, for the banana. How were the results different from your predictions?
5. Now take one of your objects that proved to be an insulator, soak it thoroughly with water, and try the experiment again. Were the results different? Why?

Item	Prediction ("I" or "C")	Result ("I" or "C")
	→	→
	→	→
	→	→
	→	→
	→	→

DO THE SAFE THING

Metal is a really good conductor. That's why you should never stick a fork into a toaster or use a metal ladder around power

Electric Art

by Connie Hutterer

Artist: Eric Ehlenberger, www.neonSculpture.com Photo: Gerard Perrone

Neon signs have been popular for 100 years. But artists also use neon. Neon artists call themselves "tube-benders." They use three ingredients to make their magic: glass, gas, and "juice" (electricity).

GLASS Tube-benders heat a glass tube to about 1200°F (649°C) until it's soft. Then they bend it into a letter or curve, blowing into it through a long rubber hose to keep it from collapsing. Next, they clean the tube by bombarding it with electricity. The power comes from a transformer the size of a trash can, which converts 220-volt power into 15,000 volts. Once electricity loosens any dust inside, the tube-benders vacuum it out—along with the air. If air or anything is left inside, the tube won't glow.

GAS The artists fill the tube from a tank of neon or other gas. Different gases produce different colors. Neon has a bright orange light. Argon glows pale purple. Helium makes a pale peach, and krypton makes silver. They can be blended with colored powder or put into colored glass to make various shades.

JUICE Electricity for the finished product comes through a tiny transformer. When it's plugged in, electricity flows through the tube, energizing the gas atoms inside and making them glow. ■

Think About It! How is electric art like lightning in a tube?

Zapped! SCIENCE

Like tube-benders, your local electric utility uses transformers to change the voltage of electricity. Transformers at power plants increase electricity's voltage so it can travel long distances over large transmission lines. Transformers in substations, on power poles, and on the ground reduce power line voltages to levels that can be safely used in homes and businesses.

DO THE SAFE THING

- Don't shoot at or throw things at transformers on power poles.
- Stay out of substations, which contain transformers and other equipment that can shock or kill you if you touch it.
- Keep away from pad-mounted transformers. Report an unlocked transformer to your local electric utility immediately.

Electric Fish

Above: Electric eel
At right: Pacific electric ray

Ray photo by Steve Benavides. Eel photo by Ken Lucas/Steinhart Aquarium, San Francisco, CA

The people of ancient Rome used electric fish as a kind of shock therapy. They would drop the fish on sick patients' heads and hope the shock would make them think more clearly!

Your body makes electricity to help your heart beat and make your muscles move, but some fish can generate enough electricity to knock down a horse!

Electric fish are known as Torpedinidae. In Latin, Torpedinidae means "fish" and "numb"—if these fish hit you, you will be numb! Their zap feels like the electric shock you'd get from an exposed light socket, and it can be just as dangerous.

Scientists are most interested in electric eels, because they make the most electricity. Electric eels can deliver a shock of up to 600 volts—as much as five times the voltage from a wall outlet. It's more than enough to kill you.

Electric eels use their electric charge for defense or to stun or kill prey. Water is a very good conductor of electricity, so when the electric eel gives off a shock, the water carries the electricity to any fish swimming nearby, making them easy pickings for the eel.

After giving off one electric discharge, electric eels must rest to recharge their "batteries." And that's a good way to think of these creatures. Electric eels really are like living rechargeable batteries.

Just like in a battery, chemicals

DO THE SAFE THING

Many electrical injuries occur in kitchens and bathrooms and involve water.

- Make sure your hands are dry before you touch anything electrical, even if you think it's turned off.
- Keep electric cords and appliances away from water, and unplug appliances before cleaning them.
- Use only a battery-powered radio or boom box near a swimming pool or during other water play.

Tales

by George Snyder

Zapped! SCIENCE

Electricity travels very easily through water. That's why it's such an effective tool for electric fish. The human body is 60-70 percent water. That's why your body can conduct electricity!

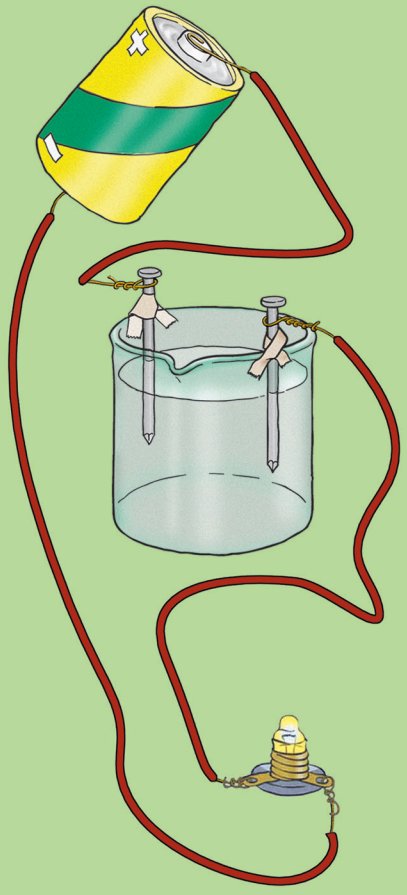
inside the eel react with each other to make electricity. Batteries have positive and negative poles, and so do electric eels. The eel's head is the positive pole, and its tail is the negative pole. When the eel discharges, the current can flow from either its head or its tail.

Nearly all of an electric eel's long body is taken up by its electric organs, which contain 5,000 to 6,000 little parts called electroplaques. Each electroplaque produces only a small amount of electricity, but when all the charges are added together, they pack quite a wallop!

You may be wondering if electric fish ever shock themselves. They do, but their bodies aren't affected by it. That's something scientists want to learn more about. ■

Think About It! How many 9-volt batteries would it take to equal the shock from one electric eel?

Will the Bulb Light?



1. Using the light bulb, battery, and wire from your p. 6 experiment, set up the equipment as shown and fill the beaker with distilled water. Does the bulb light?

2. Add salt, one-quarter teaspoonful at a time, to the water. How much salt does it take to make something happen?

3. Pour the water out and repeat the experiment several more times. In place of the salt use other particles such as dirt, bread crumbs, blackboard chalk, etc. Each time you try a new substance, start over with fresh water and wipe off the nails and exposed copper wires.

4. Create a data table where you can record your observations and note how much of each substance it takes to get a result. Use your observations to formulate a hypothesis about what is needed for the bulb to light.

SAFETY TIP: Electricity from outlets has more than 80 times the voltage of your D battery, and will travel through water whether or not it has impurities in it.

Lighting Treasure

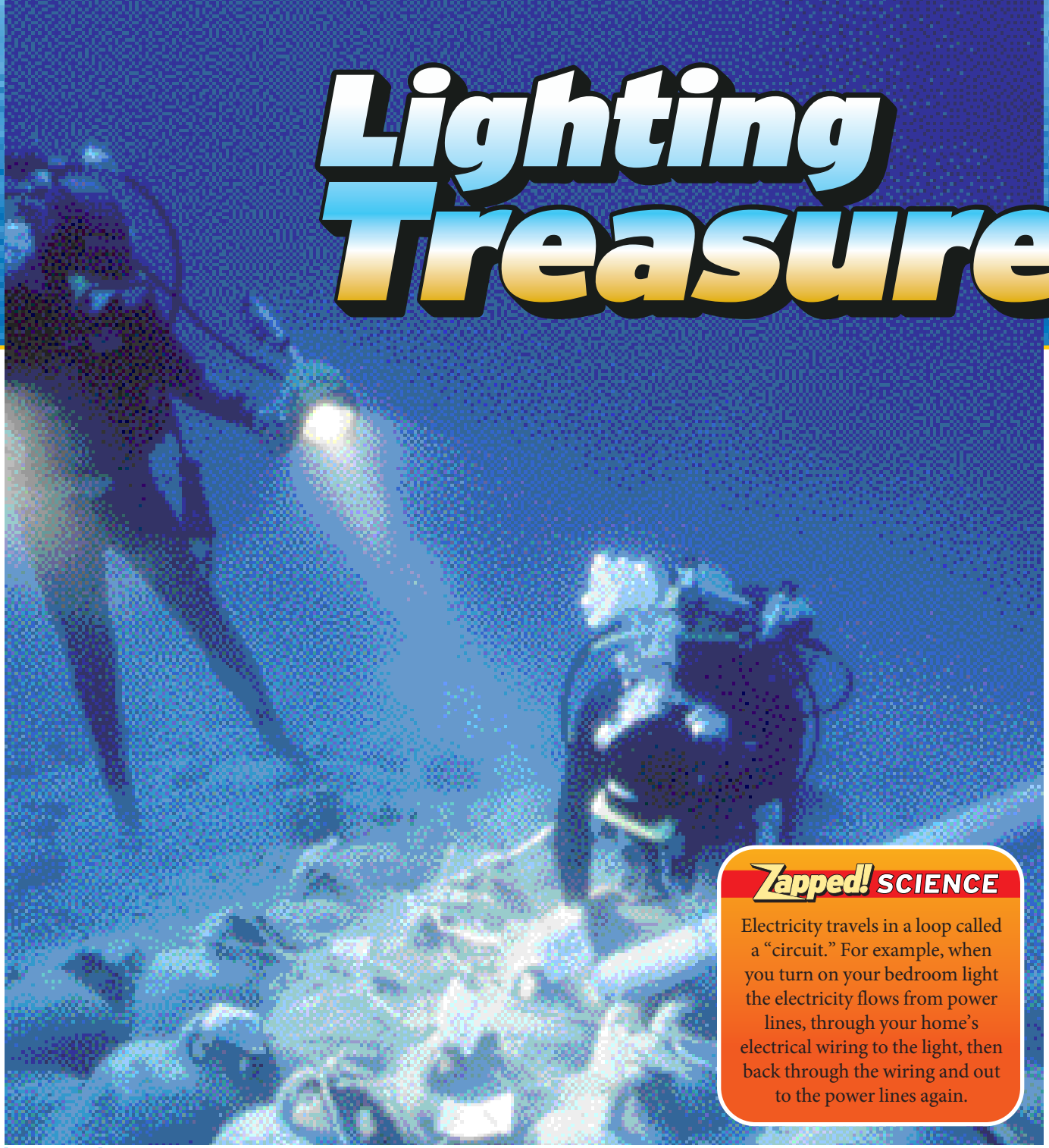


Photo courtesy of the Institute of Nautical Archaeology, Texas A&M University/Don A. Frey

Zapped! SCIENCE

Electricity travels in a loop called a "circuit." For example, when you turn on your bedroom light the electricity flows from power lines, through your home's electrical wiring to the light, then back through the wiring and out to the power lines again.

To explore sunken ships and recover their treasures, divers need lights, cameras, and other equipment, all of which run on electricity. Since water is such a good conductor of electricity, treasure hunters must take special precautions to use electricity safely. Here's how they do it.

Diesel generators on the treasure-hunting ships provide the electricity. From the onboard generators, special cables carry the electricity down through the water to the divers' equipment. The electricity is wired through a ground fault circuit interrupter (GFCI) panel at the generator. If a GFCI detects that electricity is leaving a circuit, it quickly interrupts the flow of current to prevent shock. This is similar to the wiring in newer homes, where electricity to outlets near kitchen and bathroom sinks, in basements, in garages, and outdoors is wired through GFCIs to protect people from serious shock.

by Jonathan Marmelzat

Hunts

DO THE SAFE THING

If you see someone using electricity near water, remind them to plug their appliance or their equipment into a GFCI-protected outlet or

Various types of insulation also help protect divers. Each underwater cable is insulated by a plastic shield, and inside is a bundle of individually insulated wires. There can be no air inside the cable. This is important because air expands and contracts with the pressure changes of different ocean depths. Expanding air could crack the insulation, which would allow water to leak in and electricity to come out. If that happened, electricity could shock the divers, fish, and any other living thing nearby. (In most cases, the GFCI would activate before that could occur.)

At the dive site, high-powered lights are insulated from the water in special cases filled with a compressed gas. The gas keeps the pressure from building up inside the light and causing a leak. Hand-held lights and cameras are often powered by battery packs strapped to the divers' air tanks. Divers always wear special rubber gloves when handling electrical equipment.

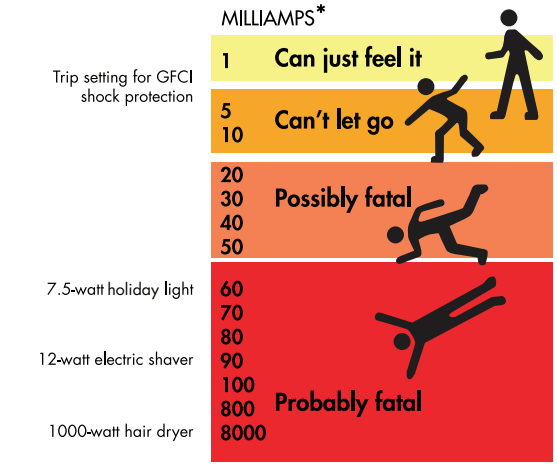
Even with all these precautions in place, before each dive treasure hunters check their equipment carefully for signs of wear or damage. When they see sunken treasure gleaming in the light of their electric lamps, they know all their electrical safety efforts have been worth it! ■

Think About It! What could cause a GFCI to activate for divers? What could cause a GFCI to activate in your bathroom or kitchen?

Just a Little Current Can Kill You

Electricity's effects depend on the pressure (measured in voltage, or volts), the current (measured in amperage, or amps), and the duration of the contact. High-voltage electricity from power lines can burn you from the inside out. It can also blast you clear of the circuit, but the shock or fall can be fatal. Low-voltage electricity (such as that found in your home and shown in the chart below), can cause muscle spasms that lock you to the circuit. It can also interfere with your heartbeat, even if the amperage is very small.

Just a Little Current Can Kill



* A milliamp is 1/1000th of an ampere, a measure of electrical current.

1. What could happen to someone who contacted 1 amp?

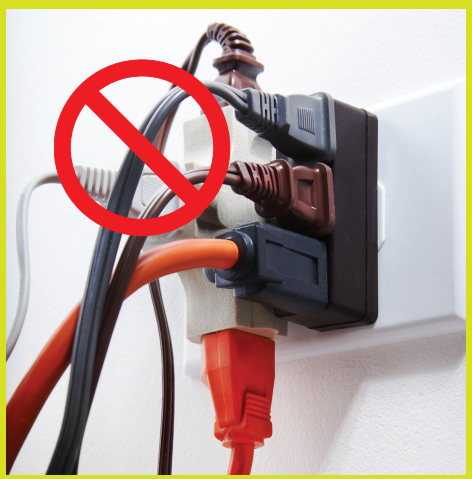
2. Why do you think GFCIs are set to trip (stop the flow of electricity) at 5 milliamps?

Is Your Home Safe?

Use this checklist to inspect your home with a parent or other adult.

LOOK FOR	OK	NEEDS FIXING	FIXED
1. Overloaded outlets			
2. Worn or frayed appliance cords or extension cords			
3. Electric cords running under rugs or furniture legs			
4. Kitchen or bathroom appliances used near water			
5. Electric heaters close to anything that can burn			
6. Circuit breakers that trip (or fuses that blow) often			

Overload Alert!



Zapped! SCIENCE

Amperage (amps for short) is a measure of the AMOUNT of electricity used. Voltage (volts) measures the pressure, or FORCE, of electricity. The amps multiplied by the volts gives you the wattage (watts), a measure of the WORK

Most household circuits are rated for 15 amps (20 amps for kitchen circuits). If you run multiple appliances at the same time on a single circuit, and their combined amps exceed the amps of that circuit, the wiring could get overloaded, melting insulation and causing a shock or fire hazard. That's when fuses should blow or circuit breakers cut power to prevent problems.

APPLIANCE	WATTS	AMPS
Toaster oven	1200	10
Iron	1080	
Portable heater	1500	
Television	168	
Answering machine	6	
Coffee maker	900	
Microwave oven	996	
Vacuum cleaner	1224	

Determine the amps used by each appliance in the table. Assume 120 volts and use the formula watts / volts = amps. (Example: For the toaster oven, 1200 watts / 120 volts = 10 amps.)

Which three appliances could you run at the same time from a 20-amp kitchen circuit?

_____

_____

_____

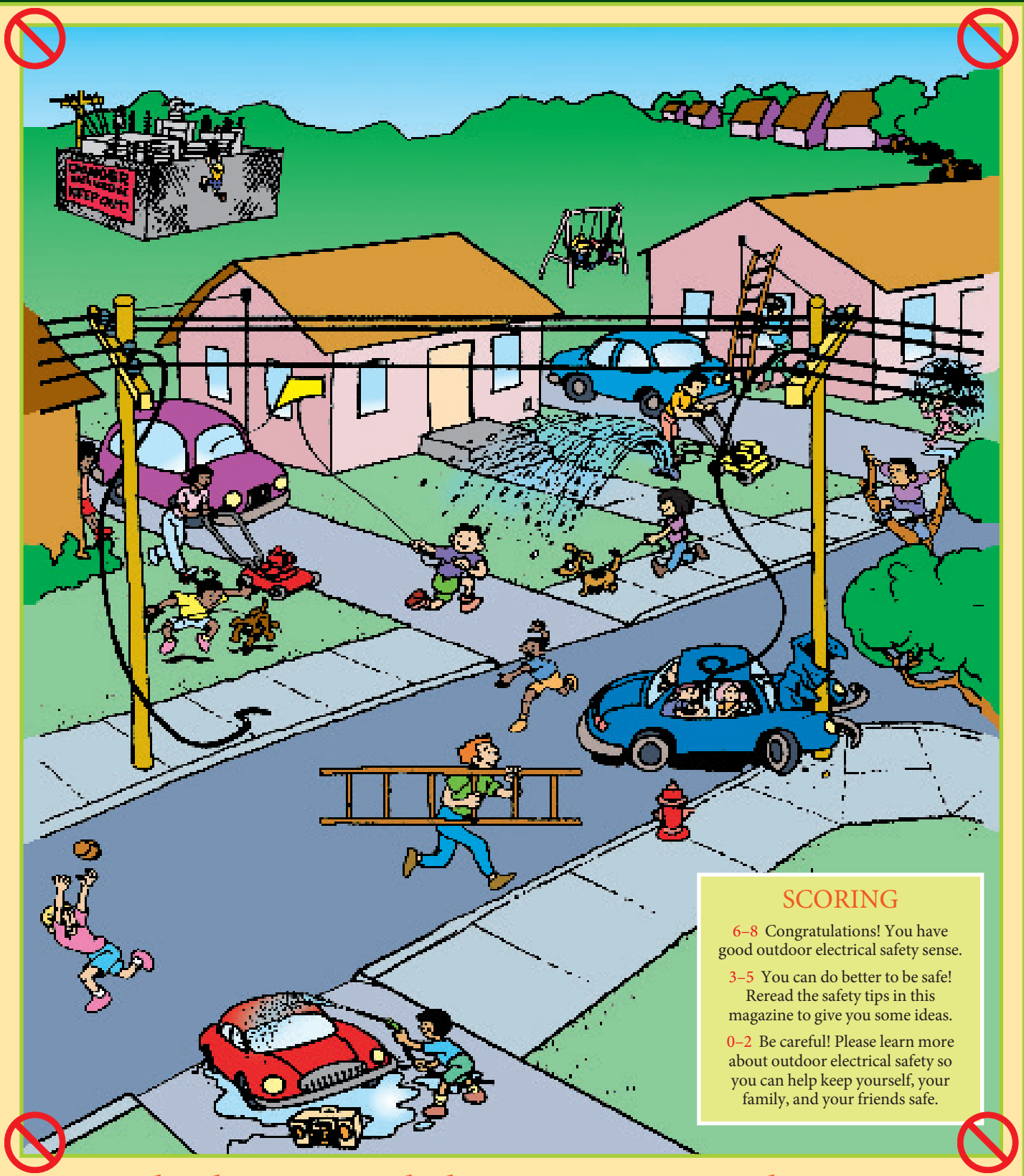
Which two appliances would overload that circuit if you were to use them at the same time?

_____

_____

_____

Think About It! Have you ever overloaded a circuit? What happened?



SCORING

6–8 Congratulations! You have good outdoor electrical safety sense.

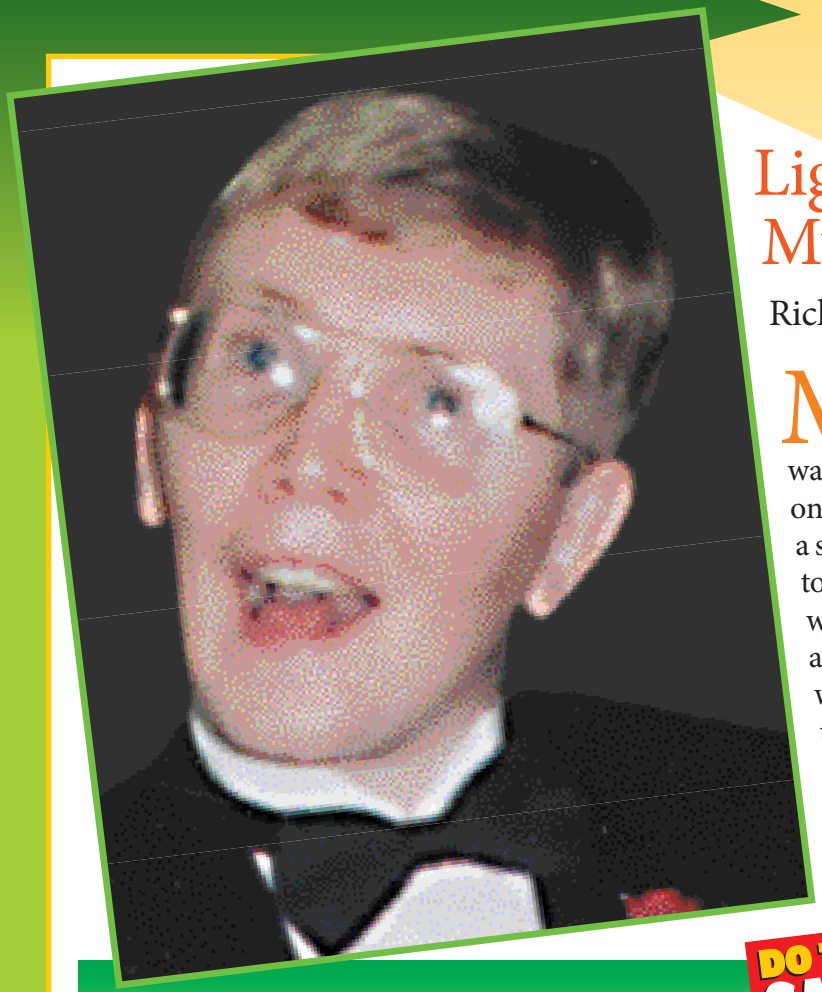
3–5 You can do better to be safe! Reread the safety tips in this magazine to give you some ideas.

0–2 Be careful! Please learn more about outdoor electrical safety so you can help keep yourself, your family, and your friends safe.

Find the Hidden Hazards

There are eight hazardous electrical situations in this neighborhood. For each one you find, answer these questions: What could happen to the person involved? What should he or she do right now to be safe? What could he or she have done to prevent this situation from occurring?

Lightning and Storm Safety



Lightning Changed My Son's Life Forever

Richard from Lansing, Michigan

My son John was 17 years old and just a year from graduating from high school when he was struck by lightning. John and three friends were on the golf course when a storm came up. They took cover under a wooden shelter and then started walking back to the clubhouse.

John was the tallest, and he was carrying his golf clubs. The lightning struck him and traveled through his body into the ground. His three friends were knocked unconscious, but John was injured the most.

Since the accident, John can't speak, walk, or write. He can laugh and cry, make sounds, read, hear, and understand things, but he cannot talk or move by himself.

John wants you to know that if you see a storm coming or hear thunder, you should get inside. Even if you really want to stay on the ball field or golf course, leave! John is proof that lightning can strike you.

Zapped! SCIENCE

A lightning bolt can carry over 100 million volts of electricity—more than 8 million car batteries! Lightning is attracted to metal, water, and tall objects, including trees, buildings, and people. About 100 people are killed and more than 1,000 people are

DO THE SAFE THING

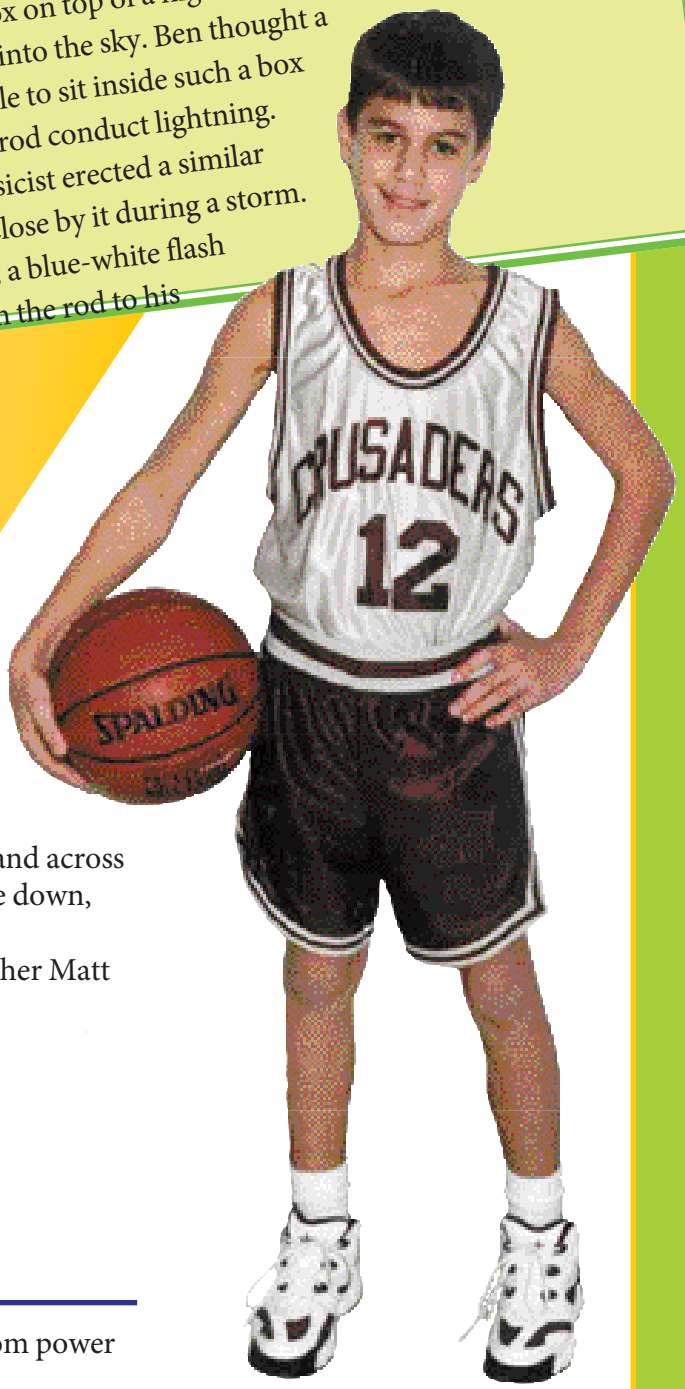
Plan ahead so you don't get caught outside during a storm. If you see lightning or hear thunder, go indoors immediately. Lightning can travel through wiring and water pipes, so stay away from bathtubs, sinks, phones, and anything that uses electricity, like TVs, computers, video games, or appliances.

IF YOU CAN'T GET INDOORS:

- GET into a hardtop car—not a convertible.
- STAY away from trees, tall objects, and anything metal.
- STAY away from rivers, lakes, and swimming pools.
- IF you are caught in the open, drop to your knees and bend forward, putting your hands on your knees. Do not lie down or put your hands on the ground.

Ben Franklin Was LUCKY!

Benjamin Franklin experimented with electricity long before its dangers were well understood. Luckily, the famous kite Franklin flew during a thunderstorm only ended up drawing electrical charges from the air—if the kite had actually been struck by lightning, Franklin would have been killed! It was also Ben's great good fortune that he never built one of his most ambitious lightning experiments: a box on top of a high tower, with a pointed iron rod rising 30 feet from it into the sky. Ben thought a person would be able to sit inside such a box and safely watch the rod conduct lightning. In 1753 a Swedish physicist erected a similar contraption and stood close by it during a storm. When lightning struck, a blue-white flash of electricity darted from the rod to his



I Felt Like I Was on Fire!

Nathan from Collinsville, Illinois

It was storming really bad, and my mom called and said to go to the basement because of the storm.

I went to the garage first to get my cats, and the door blew open. When I reached to shut it, I heard a loud bang like a loud firecracker. My hand was stuck to the doorknob.

I saw a zigzag blue streak of lightning go up my right arm and across my chest. It went out my left shoulder. The force knocked me down, and I could see static electricity fly across the garage.

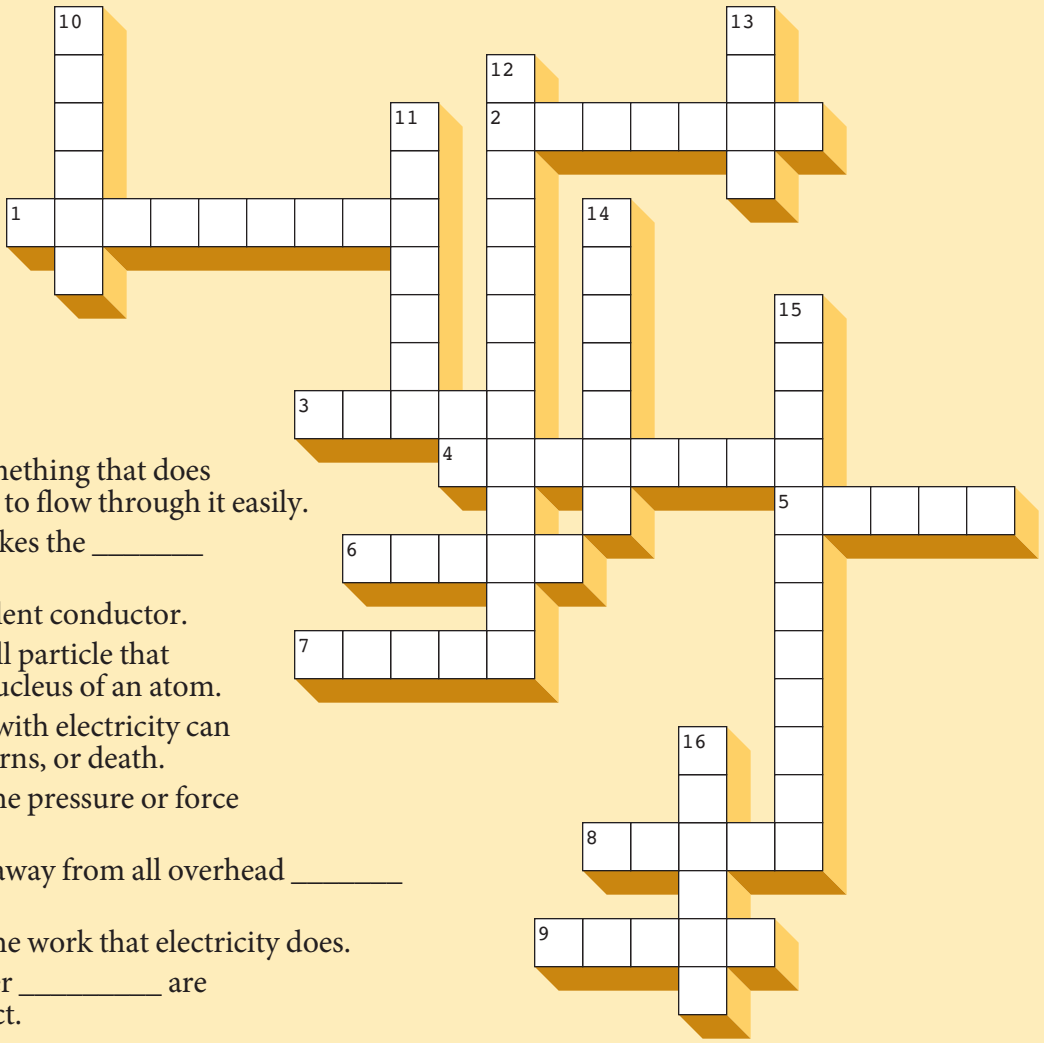
It hurt so bad, like I was on fire. I went in and told my brother Matt to call 911, because I had been struck by lightning. He thought I was joking until I took my shirt off and he saw that I was burned. An ambulance took me to the hospital.

For a long time afterwards, I had pain and numbness in my shoulders, and the static electric charge in my body made computers, monitors, and printers mess up when I was around. I still have memory problems and sometimes can feel a storm approaching.

Think About It! How is lightning similar to the electricity from power lines?

What Do You Know About Electrical Safety?

This puzzle includes fun facts about electricity and how to be safe around it. You can find all the answers inside this magazine.



ACROSS

1. An _____ is something that does not allow electricity to flow through it easily.
2. Electricity always takes the _____ path to the ground.
3. _____ is an excellent conductor.
4. An _____ is a small particle that orbits around the nucleus of an atom.
5. Coming in contact with electricity can cause _____, burns, or death.
6. _____ measure the pressure or force of electricity.
7. Stay at least 10 feet away from all overhead _____ lines.
8. _____ measure the work that electricity does.
9. Underground power _____ are dangerous to contact.

DOWN

10. If you contact electricity and the _____ at the same time, you will be shocked or electrocuted.
11. The loop electricity travels in is called a _____.
12. A machine that delivers an electric shock to restart a patient's heart is called a _____.
13. Ancient Romans used to drop an electric _____ on sick people's heads to make them think more clearly.
14. Water will _____ electricity very well.
15. Report unlocked pad-mounted _____ to your local electric utility immediately.
16. An overloaded _____ can cause an electrical fire.