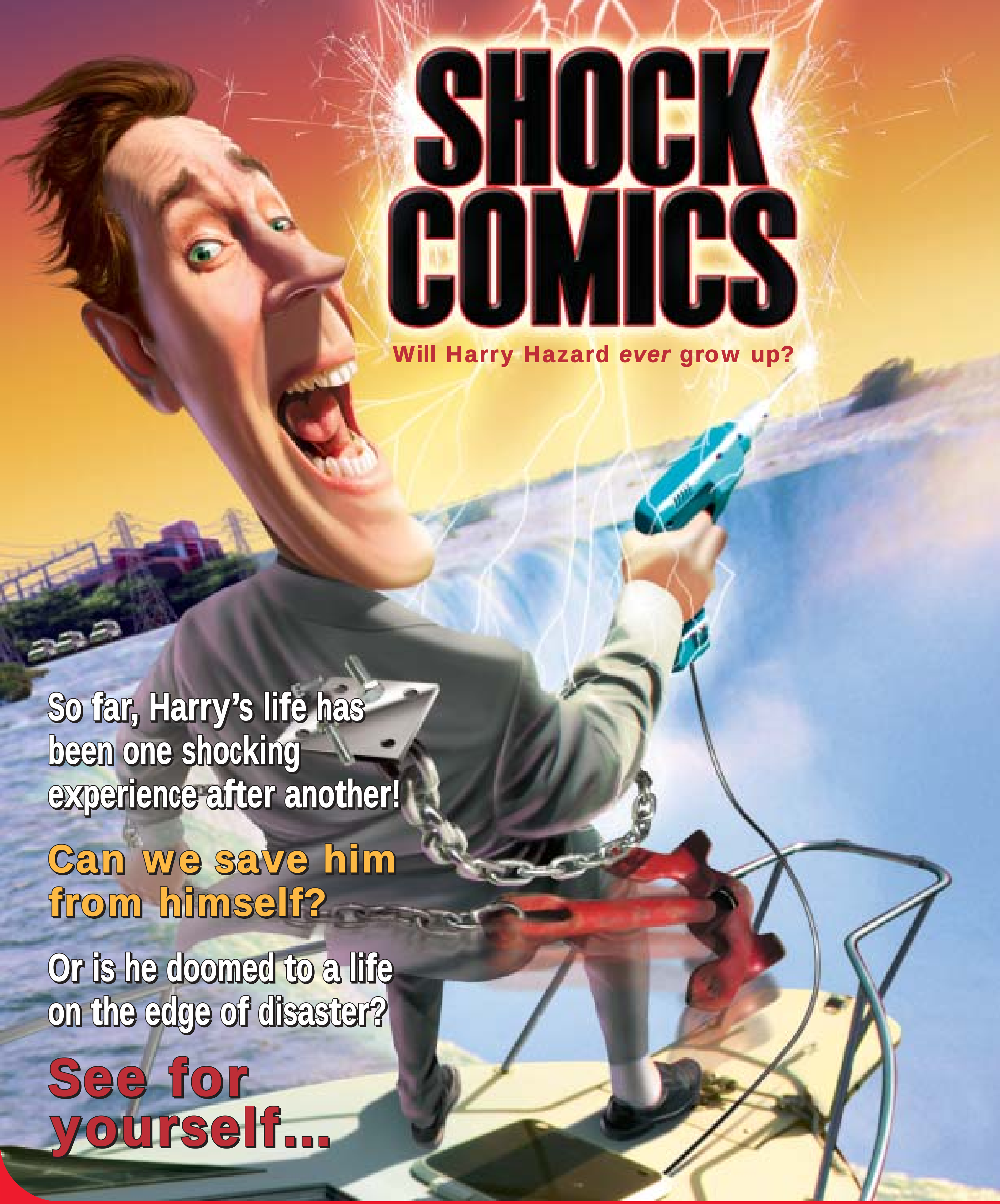


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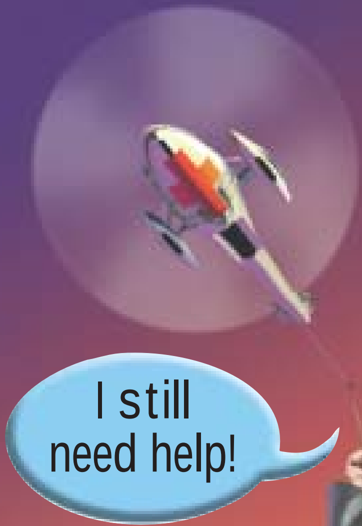



### Eureka!

The ancient Greeks discover that amber, rubbed with fur, attracts light objects such as feathers. The word electric comes from the Greek elektron, meaning amber.

# The trouble with Harry...

is that he just doesn't get it. You may know Harry if you've been on a tour of Hazard Hamlet, a very dangerous place. You might have seen him get zapped, shocked and sizzled, over and over again. Actually, it's not Hazard Hamlet, or electricity itself, that's dangerous. It's Harry's lack of knowledge about electricity that gets him into serious trouble.

You're learning all about energy and electricity in science class. Perhaps if we all work together, we can help Harry out, and have some fun while we're at it. Maybe this time he'll finally get it!

### Fast fact!

Did you know that electricity travels at the speed of light, almost 300,000 kilometres per second, or 1.08 billion kilometres per hour? When you think that a speeding car on the highway is only moving at 100 kilometres per hour, that's fast!

# Watt's up?

Harry's partly right this time. It's not that complicated. As you're learning in science, electricity is actually pretty simple stuff, once you understand four words: **amperes**, **volts**, **ohms** and **watts**.

**Amperes**, or amperage, measures the volume of electricity in a circuit. The stove in your kitchen needs a lot more amperes than your CD player.

**Voltage** measures how much electrical pressure is pushing those amperes (or amps) through a circuit. The stove needs 220 volts to operate, while most other electrical appliances in Canada are designed for 110 volts.

**Ohms** measure electrical resistance, or how easily a material conducts electricity. The wire inside your toaster has higher resistance (you want it to get hot!) than the wire inside an extension cord, which only gets slightly warm.

If he's been doing his science homework, Harry might remind us about **watts**. Watts (always the number of amps multiplied by the number of volts) are just a convenient way to measure how much power is being used. You can see how watts work at home by looking at the differences in light produced by a 60 watt bulb and a 100 watt bulb.


**Let's find out exactly what Harry knows**

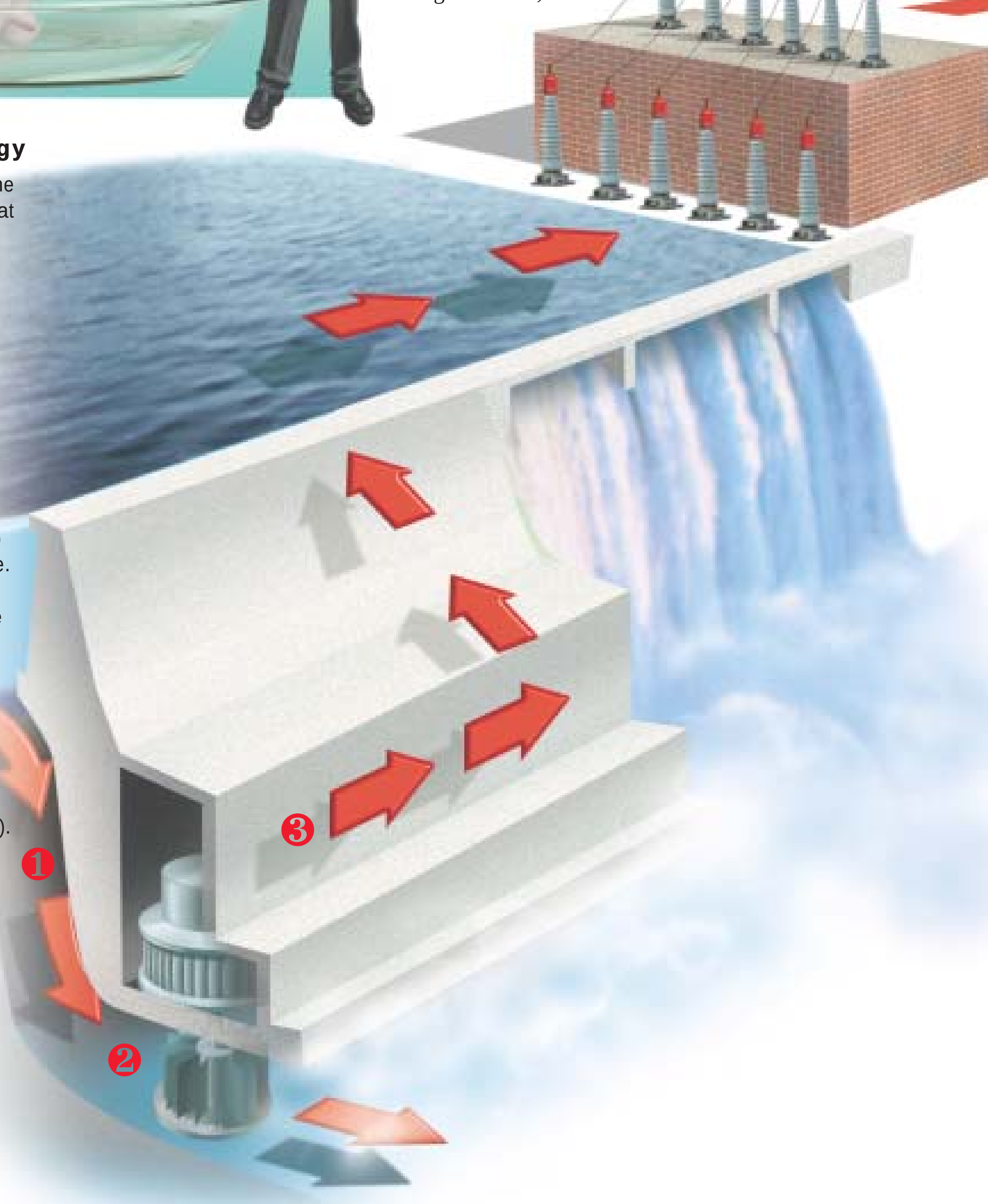
Using electricity safely may be a little more complicated, at least for Harry. Maybe he's been indoors too much. So, let's start at the beginning. On the next page we'll take Harry out on a tour that explains how electricity is produced and delivered, and see what he knows.

# Harry sees the light *(we think!)*

Energy is never actually created, but is just changed from one form to another. Here at the generating station (below), the power of the ❶ waterfall moves the ❷ turbines, which turn the ❸ generators.

The generators produce electricity, which flows through a transmission substation to transmission lines, then on to a distribution substation and distribution wires to our homes, schools, farms, and factories.

Generators like this one produce power at voltages from 2,000




### Help Harry transform energy

You can make your own water turbine that works the same way as the one at the waterfall.

**You'll need:**

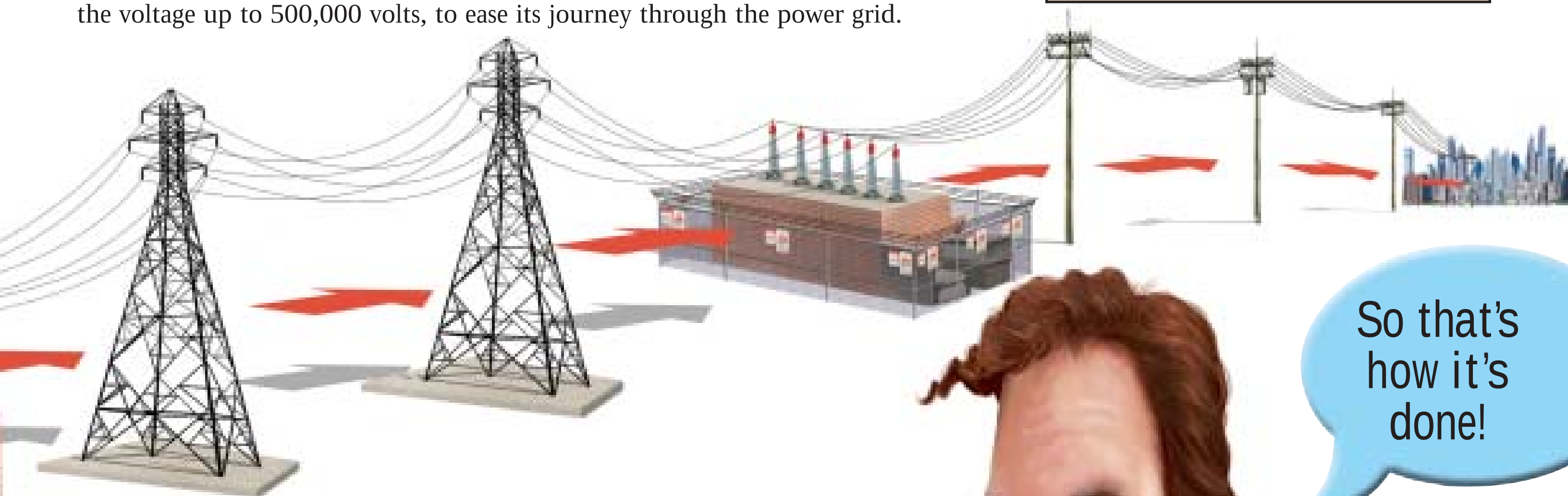
- An adult to help you
- A two-litre plastic pop bottle
- Six screw-type plastic pop bottle tops
- One plastic margarine container
- Waterproof glue, scissors
- One wire coat hanger
- Two thick rubber bands or duct tape
- A dish or container.

1. Cut a small round hole in the pop bottle, about 10 cm from the base.
2. Cut two disks (7.5 cm diameter) from the margarine container, make a small hole in the middle of both.
3. Glue the bottle tops on one disk so they act as cups to catch the water.
4. Glue the other disk on top to make a wheel.
5. Push the coat hanger through the wheel and bend it as shown (above).
6. Attach your wheel to the bottle with rubber bands or duct tape.
7. Fill the bottle with water. As the water flows out of the hole, it turns the wheel.

What you have done in this experiment has changed the kinetic and potential energy of water into mechanical energy.

| OHM'S LAW | | | | |
|---|---|---|---|---|
| VOLTS | = | AMPS | x | OHMS |
| AMPS | = | VOLTS | ÷ | OHMS |
| OHMS | = | VOLTS | ÷ | AMPS |
| WATTS | = | VOLTS | x | AMPS |

to 22,000 volts, but even that much electrical pressure isn't enough to send the power on its way to your house. Transformers near the power station can boost the voltage up to 500,000 volts, to ease its journey through the power grid.



The power is eventually reduced at distribution stations in your neighbourhood, but it is still at a voltage of between 4,000-12,000 volts. That's way too much voltage for anyone to use safely, so it's reduced again to 120 or 240 volts, through a pole top or pad mount transformer, before it reaches your home or school.

Turn the page, and you'll see that Harry still has not seen the light. Do you know what the signs at a substation mean?


### It's a date!

1820: André Marie Ampère discovers that a coil of wires acts like a magnet when a current is passed through it.

### Generators convert energy

Inside a generator is a magnet (magnetic field), a coil of wire (carrying current) and a source of mechanical energy (movement). The mechanical energy moves (rotates) the magnet which is surrounded by the coil of wire. The magnet creates a magnetic field and as it moves, the magnetic lines of force cut through the coils. As a result, electric current is produced in the wire.

It does not matter whether the magnet or the coils of wire are moved. The important thing is that there is motion within the magnetic field to cut the magnetic lines of force.

## Mind the transformer

You've probably seen one of these pole top transformers on a utility pole near your home. As long as it's left alone way up on the pole, it's safe. If you ever notice a transformer that's been damaged, tell an adult, and stay away.

# Harry is transformed!

There were no tour guides or teachers to explain things to Harry at the substation near his home, and he did not understand the danger when his Frisbee went over the fence. We could have saved Harry a zapping, if only he'd asked, or read the signs. Harry did not realize that the transformer and other electrical equipment in this distribution station could seriously hurt him, even if he did not touch the equipment.

A substation is dangerous, and it's no place to play. You may have seen one in your neighbourhood, and noticed the warning signs and fences to keep people out. As you can see from Harry's experience, there's a good reason to ask an adult to call the power company if a ball or toy winds up in a substation. They'll send a trained technician out to safely retrieve it.

## Big game, low voltage

Small transformers are used with most of the electronic equipment we all enjoy – games, computers, radios, CD players, TVs. They reduce the 120 volts from your wall socket to the lower voltages needed for electronics, and save you from buying a lot of batteries! Whether they are small or large, transformers operate in the same basic manner, to increase or reduce voltage.

## It's a date!

Back in 1799 Alessandro Volta builds the first electric battery.

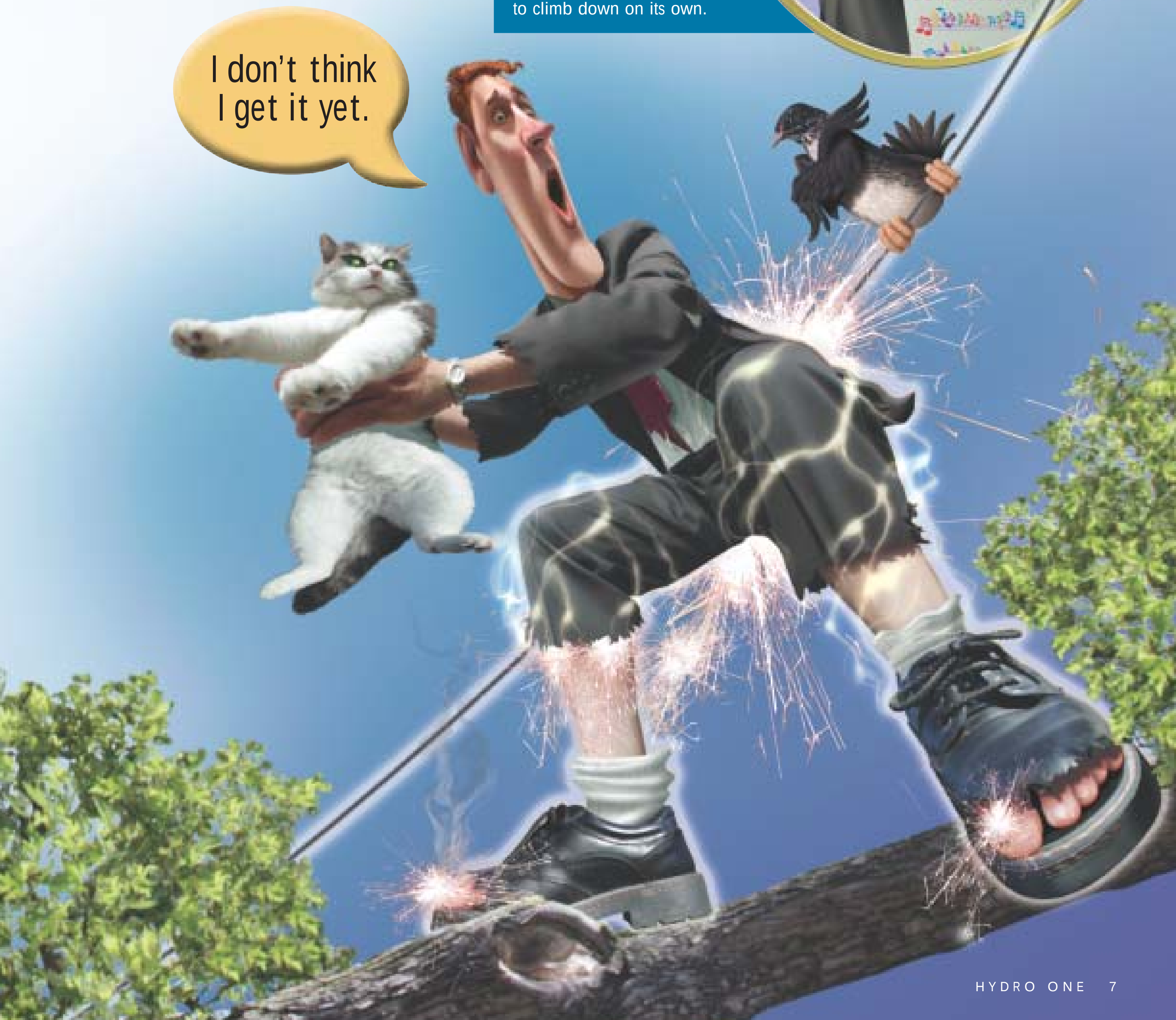
# Why doesn't this bird ~~fly~~ fry?

Ever wonder why birds and squirrels don't get zapped more often? This bird below, and millions of its feathered friends owe their lives to something called the Faraday Principle. As long as it doesn't come into contact with anything that leads to the ground, the bird is energized at the same voltage as the power line it's perched upon. Electricity always looks for the easiest path to the ground. If there is no path to the ground, there's no shock.

Harry, on the other hand, is giving the electricity flowing through the wires a clear path, through his body, down the tree and into the ground. Harry is part of an electrical circuit, which as we can see, is not a good thing to be.

**Will the cat come back?**

Cats love to climb, and sometimes they get stranded on utility poles and in trees. Like all cats, Harry's feline friend will eventually get hungry enough to climb down on its own.

## Call 911 in an emergency

If you are with someone who is being shocked by electricity, don't touch them or the thing that shocked them. Call 911 if the person needs help. Cardiopulmonary resuscitation (CPR) is the best emergency first-aid treatment for victims of severe electrical shock. It can only be done by people who have been trained in it. Ask your teacher where you can learn more about taking CPR training.

# The shocking story

Harry's been getting a lot of shocks in our story, so we can show you the consequences of his unsafe behaviour. We should also remind Harry that all shocks are not created equal.

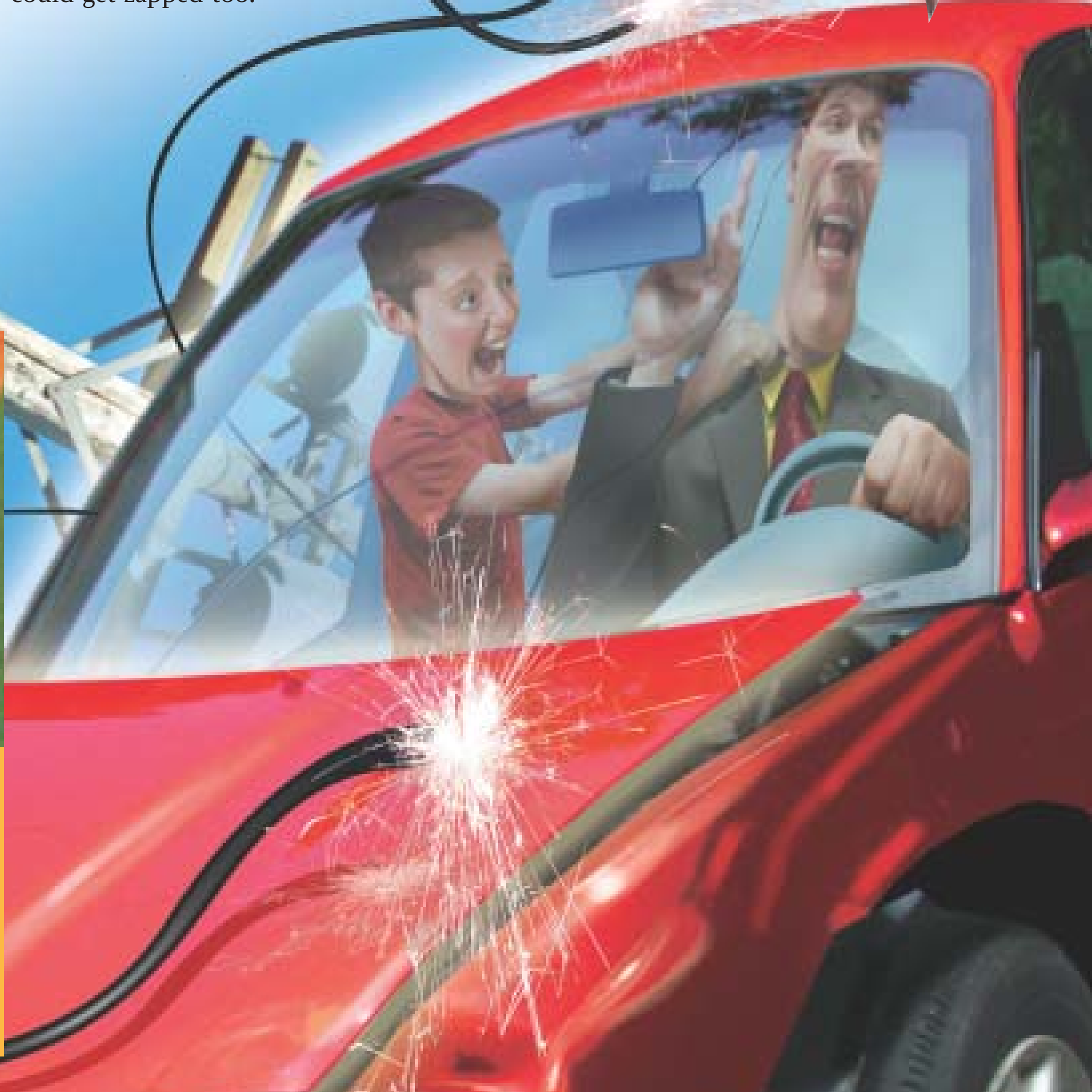
There are actually two types of shocks that you can suffer if you come between electricity and the ground. The first is the static shock you can get after walking across a thick carpet in a dry room. In more severe shocks, electric current can burn the skin, nerves, muscles and tissues in the body. Medical treatment is necessary. A severe electrical shock can directly cause death in three ways:

- Paralysis of the breathing centre in the brain
- Paralysis of the heart
- Ventricular fibrillation, where the heart muscle twitches very rapidly.

# Harry learns a lesson

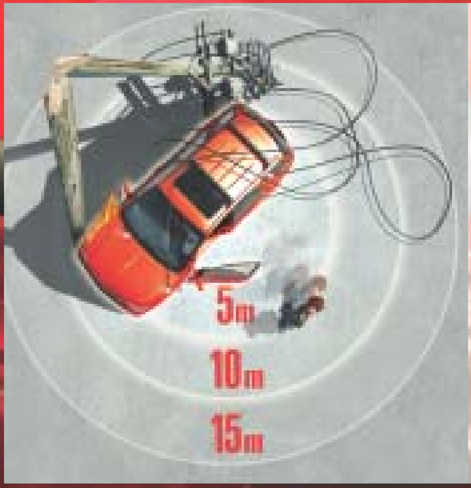
Right after his meeting with the bird, Harry had yet another misfortune. His car ran off a slippery road and smashed into a utility pole. Amazingly (for Harry) he had his seatbelt on, and wasn't hurt, but as you can see, he's still got trouble! That power line will probably zap him, if he gets out of the car and gives the electricity a path to the ground.

Hey – Harry's getting smarter! He's not moving until professional help arrives. He's also telling anyone who comes by to stay at least 10 metres or more away from the car, because they could get zapped too.




## Go fly a kite

It looks like Harry's really starting to mature. He's now realized that a kite string can easily create a path for electricity, and danger for the person flying the kite. His solution is simple: never fly a kite anywhere near overhead wires.




## A safe landing

But what if Harry had to get out? What if the car were on fire, or about to explode? Harry now knows that he should jump clear, without touching the car and the ground at the same time. Here's how to do it:

1. Remove long coats and jackets.
2. Open the car door, without letting your feet touch the ground.
3. Turn sideways on the seat, keep your arms by your side (so you don't accidentally touch the car) and JUMP only about 45 to 60 cm away from the car, landing with your feet together.
4. You've landed safely!
5. Keep your feet touching each other (so they can't turn you into a circuit) and shuffle away from the car. Or do a "bunny hop" with your feet together.
6. Shuffle 10 m or more away from the car and the nearest fallen wire.
7. Once you're out, stay away! Don't go back for any reason.

# Harry's in the dark again

Just when we thought he had seen the light about electricity and safety, Harry's back in the dark. But wait – it's not his fault this time. There's been a power failure, and Harry's ready for it. He's even sharing a list of things to do if the power goes out at our house. He's curious though – why leave a light switch on when there's no power?

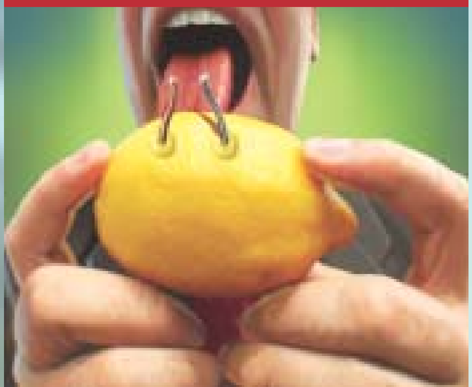

HARRY'S HIDEAWAY
ACROSS
4. Fun time
8. Whassup?
10. This measures resistance
12. Ground Fault Circuit Interrupter
11. Spins around
13. Changes the voltage
DOWN
1. Smarter than the cat
2. Electrical pressure
3. Commands respect
5. What goes around…
6. What Harry isn't – yet
7. Volume of electricity
9. Harry's experience
14. His principle keeps the birds safe

# Harry's last stand

Harry wants to sell lemonade, but we have a better idea. We can make a battery instead.

### Here's what happens

When you touch the electrodes to your tongue, the circuit is complete, and a small electric current flows. The tingle you feel in your tongue and the metallic taste is from the electrons moving through the saliva on your tongue. A single lemon produces about 7/10 of a volt of electricity.



### Here's what you need

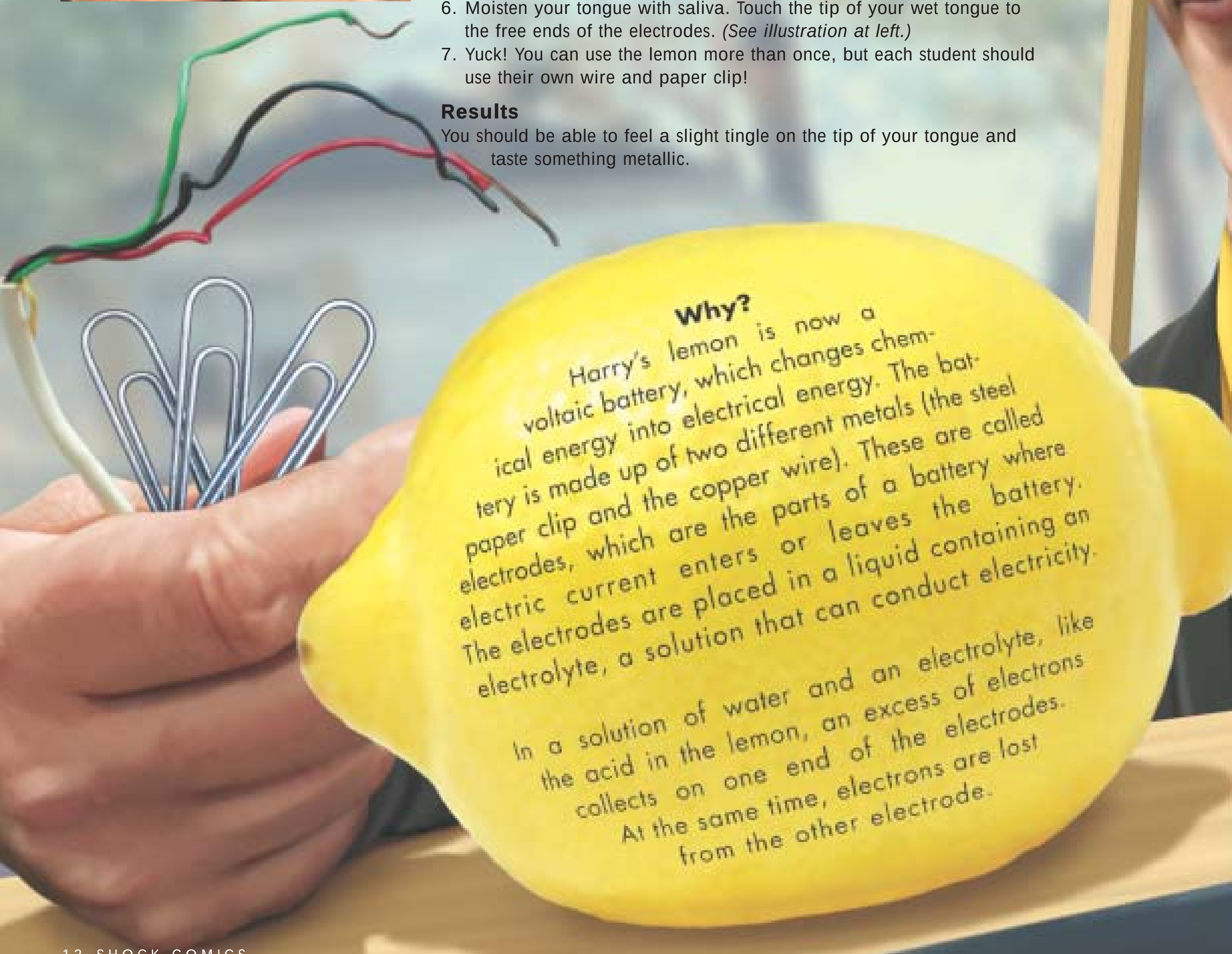
- 18-gauge copper wire
- Steel paper clip
- Wire clippers
- Sheet of coarse sandpaper
- Lemon

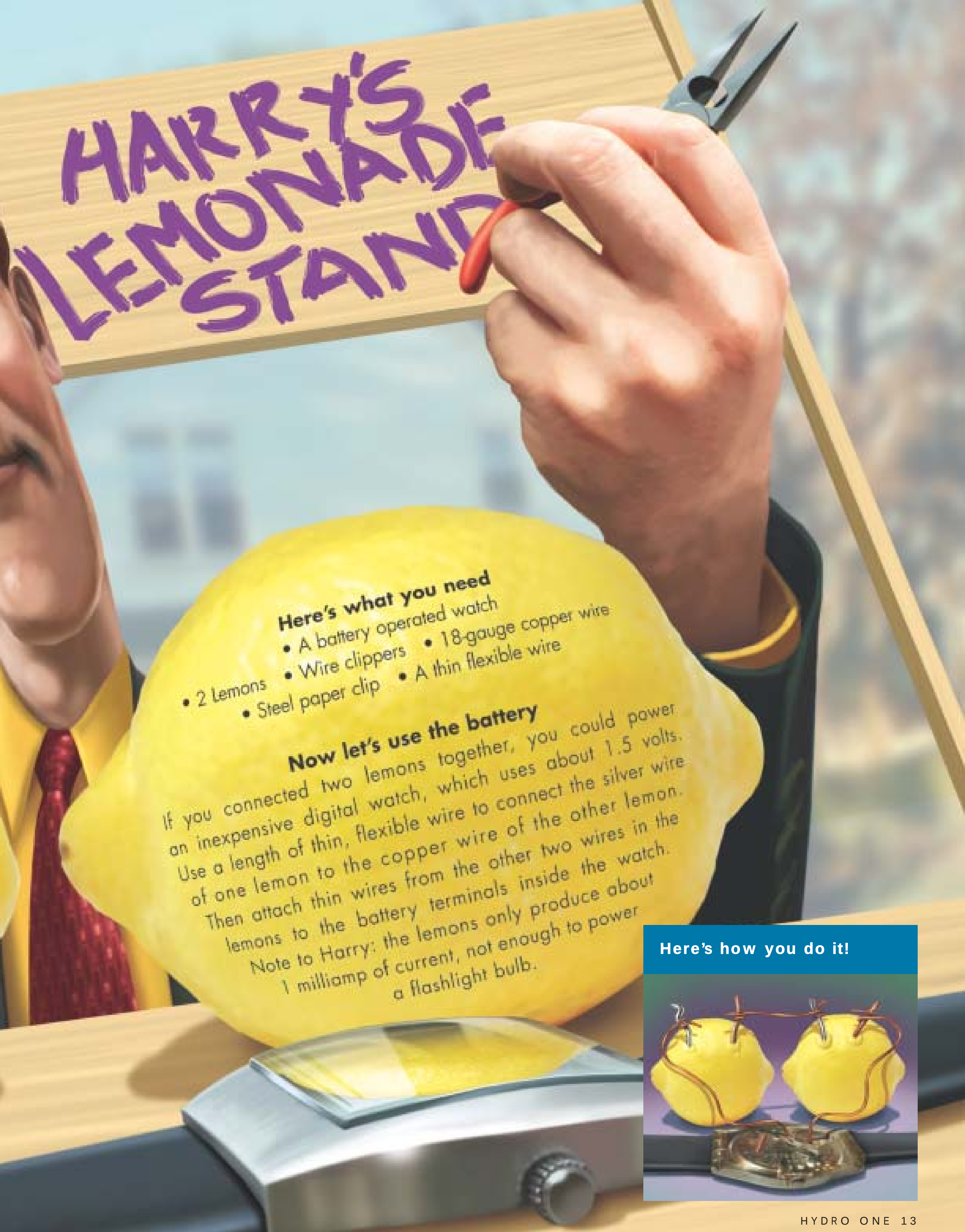
### Here's how:

1. Strip 5 cm of insulation off the copper wire. Clip the 5 cm of bare wire with the clippers.
2. Straighten out the paper clip and cut about 5 cm of the straightened steel wire.
3. Use the sandpaper to smooth any rough spots on the ends of the wire and paper clip.
4. Squeeze the lemon gently with your hands. Roll it on a table with a little pressure. But don't break the lemon's peel.
5. The pieces of the paper clip and the copper wire are called electrodes. Push them into the lemon so they are as close together as you can get them, without touching.
6. Moisten your tongue with saliva. Touch the tip of your wet tongue to the free ends of the electrodes. *(See illustration at left.)*
7. Yuck! You can use the lemon more than once, but each student should use their own wire and paper clip!

### Results

You should be able to feel a slight tingle on the tip of your tongue and taste something metallic.





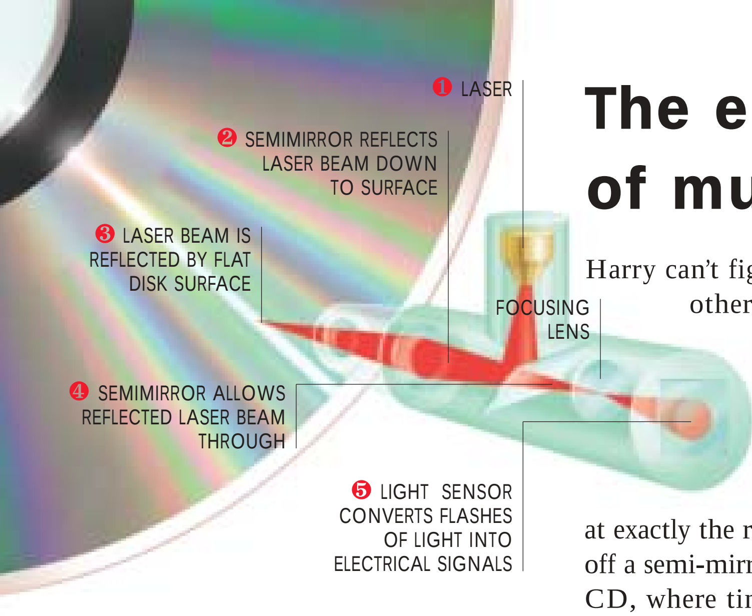

**Here's what you need**

- A battery operated watch
- 2 Lemons
- Wire clippers
- 18-gauge copper wire
- Steel paper clip
- A thin flexible wire

**Now let's use the battery**

If you connected two lemons together, you could power an inexpensive digital watch, which uses about 1.5 volts. Use a length of thin, flexible wire to connect the silver wire of one lemon to the copper wire of the other lemon. Then attach thin wires from the other two wires in the lemons to the battery terminals inside the watch. Note to Harry: the lemons only produce about 1 milliamp of current, not enough to power a flashlight bulb.

**Here's how you do it!**




# The electric sound of music

Harry can't figure out how this piece of plastic, otherwise known as a CD, can make so much noise. What happens when he inserts the CD and presses "play"? Without electricity, absolutely nothing!

An electric motor spins Harry's CD at exactly the right speed. A laser ❶ bounces light off a semi-mirror ❷ through to the silver side of the CD, where tiny marks have recorded the digital code created in the recording studio. The reflected light ❸, which now contains that code, passes back through the semi-mirror ❹ and is transformed into a series of electrical impulses ❺.

Traveling at the speed of light, those electrical impulses follow complicated circuits inside Harry's boom box. In milliseconds, they reach the amplifier, which increases the strength of the electrical signal, much like the transformers Harry saw at the power station. The electrical signal then follows another circuit to the speakers. The speakers convert the electrical energy into sound waves, and Harry can hear his favourite band whenever he wants.

### Did you know?

Thomas Edison invented the "talking machine" way back in 1877, but unlike many of his other inventions (the incandescent light bulb, for one), it didn't use electricity. It wasn't until the 1920s, when Lee DeForest invented the vacuum-tube amplifier, that we started using electricity for sound recording and playback.

### It's a date!

1947: William Shockley, John Bardeen and Walter Brattain invent the transistor. Its tiny circuits replaced the bulky vacuum tubes invented by DeForest.

### It's a date!

1971: A team at Intel Corporation introduces the microprocessor, now used in everything from home computers to microwave ovens.

# At home with Harry

The power's back on in just a few minutes at Harry's house, and he's been working on the crossword puzzle (page 11). He got most of the answers, too, and things were looking up. Until, that is, he decided to cut the wet lawn with his electric lawnmower.

Harry's electric lawnmower works by converting electrical energy into mechanical energy. However, the cord for Harry's lawnmower is worn a bit, and with him standing on the wet grass, he was primed for yet another zapping. Luckily, his house has outside outlets that are fitted with the proper Ground Fault Circuit Interrupters (GFCI). The GFCI instantly sensed the ground fault that was about to send a shock through Harry. It stopped the flow of electricity in a fraction of a second. If you remember, electricity travels at the speed of light, so the GFCI has to be fast!

### What's a ground fault?

A ground fault is simply a power leak from an extension cord, power tool or appliance, caused by worn insulation or bad wiring. Electricity flows through circuits like water flows through a hose. Think of the ground fault as the leak in that hose. A fuse box or circuit breaker won't protect you from the shock caused by ground faults, but GFCIs will.

### It's a date!

1876: Alexander Graham Bell invents a device that converts sound waves to corresponding electrical signals – the telephone.

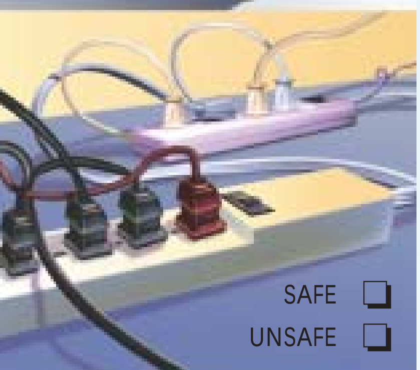
### A reminder:

The Ground Fault Circuit Interrupters in your home should be tested monthly.

# Find Harry's household hazards

Harry's really starting to "get it", isn't he? GFCIs are used outdoors and in the bathroom, and pretty well anywhere there is a risk of shock from electrical tools and appliances. They look different than regular outlets, and have a "test" and "reset" button. They really are a "lifesaver", but even if your home has them, remember to keep all electrical appliances, tools and extension cords well away from water and moisture.

But is he always safe?
Find the pictures where Harry
is still a real hazard:








# Is your home safe?

Harry's installed GFCI outlets outdoors and in his bathroom, but how's the rest of his home? How's yours? Why not check it out today after school?

**CHECK LIST:**

- ❑ Make sure plugs are connected correctly.
- ❑ Examine the condition of the cords on the appliances in your home. Look for frayed or cracked cords. Replace them if necessary.
- ❑ Extension cords are only for temporary indoor use. Make sure yours are far away from moisture and heat.
- ❑ Extension cords should not run under carpets or furniture legs.
- ❑ Do not store any flammable items near toasters, heaters, or light bulbs.
- ❑ If you have small children at your house, electrical outlets should have safety covers.
- ❑ Prepare an emergency kit so you're ready for a power failure.
- ❑ Always turn off holiday lights and decorations when you go out.
- ❑ Make sure you have a fire extinguisher and smoke alarms.
- ❑ Do not overload outlets.
- ❑ Make sure your home has GFCI outlets in the laundry room, bathroom, work areas, garage and outdoors.


**Caution**

Never insert a 3 prong plug into a 2 prong extension cord.

# Harry "aces" the test

It looks like he's done it! Harry's been studying hard, and doing a lot of extra reading. He's checked out the hazards in his house, and he knows how to avoid danger outside. He's even becoming an expert on electricity! He's also come up with his own ideas for some assignments for us.

- Create a timeline, using the data from "It's a Date!"
- Write and design an electrical safety brochure for a grade 3 student.

**Harry's also written our little test, and he's done very, very well. How will you do? All the answers to these questions are somewhere in Harry's story. Good luck!**

1. Amps, or amperage, measures the ___________ of electricity in a circuit.
2. The word electric comes from the Greek elektron, meaning ____________.
3. A bird sitting on a power line owes its life to the ____________ Principle.
4. Electricity travels at the speed of ____________, almost _______ kilometres per hour.
5. A voltaic battery changes __________ energy into electrical energy.
6. Electricity always looks for the __________ way to the ground.
7. Electrical shock happens when a _________ passes through your body.
8. If there is no ___________ to the ground, there's no shock.
9. Ohms measure electrical ________.
10. If a power line falls to the ground stay at least _____ metres away.
11. A ground fault is a _____________ __________ from an extension cord, power tool or appliance.
12. A GFCI can ____________ the flow of electricity in a fraction of a second.
13. To be ready for a power failure, you need an ___________ ___________.
14. A cat stranded on a utility pole or tree will eventually _________ _________.
15. If someone gets a shock, you shouldn't ______________ them or the thing that gave them the shock.
16. Transformers can help you save a lot of money on _______________.

**Help Harry**

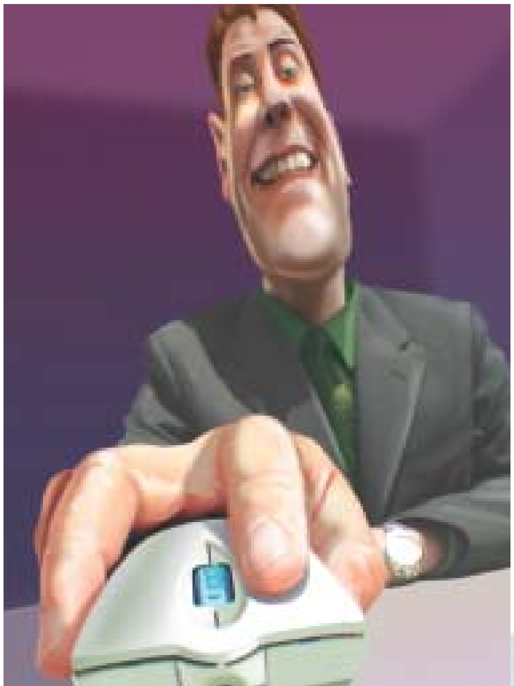
Electricity can be transformed into other forms of energy i.e., light, sound, heat and motion. Use this chart to list other electrical appliances which produce these forms of energy.

| LIGHT | SOUND | HEAT | MOTION |
|---|---|---|---|
| Lamp | Radio | Oven | Fan |
| | | | |
| | | | |
| | | | |
| | | | |

# Has Harry really grown up?

Do you have any more questions about electricity and safety, or any new ideas for projects, or safety tips?

It seems that we just can't shock Harry any more. You can still surprise him, though, if you have a question or idea about electricity or safety.



Each month, Harry will select the best questions and ideas, and send those students a special Harry Hazard prize.

Email your ideas to
***Harry.Hazard@HydroOne.com***
or mail them to
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Attention: Harry Hazard

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ANSWERS

**Page 11**
**Crossword Puzzle**

**Across**
4. recess
8. watt
10. ohm
11. turbine
12. GFCI
13. transformer

**Down**
1. bird
2. volt
3. electricity
5. circuit
6. mature
7. amperage
9. shocking
14. Faraday

**Page 18**
**Harry's Test**
1. volume
2. amber
3. Faraday
4. light, 1.08 billion
5. chemical
6. easiest
7. current
8. contact
9. resistance
10. ten
11. power leak
12. stop
13. emergency kit
14. come down
15. touch
16. batteries


ON THE ROAD
WITH
HARRY HAZARD
FIRE RESCUE