Energy 1 Express

Magazine for Grades 5 and 6

Join the cast from the TV show *Ramdam*—Selina, Manolo and Mr. Mongeau—as they learn all about electricity and electrical safety. You'll be an expert before you know it!

Hydro Québec

Hydroelectricity in Québec

The Power System

A power system is basically a series of generating stations connected by power lines to the places where the electricity is used. Most of the generating stations in Québec are hydroelectric. They use water power to produce electricity.

The first generating stations were built in southern Québec, close to most of the towns and cities. As the demand for electric power grew, Hydro-Québec had to go farther and farther north to find the right kind of rivers for generating electricity.

For example, the La Grande complex, in the Baie-James region, is over a 15-hour drive from Montréal. That's a long way for electricity to travel, right to your home!

Get Your Bearings

1. Put a red dot on the map to show where you live. Which power station is closest to your home?

   _____

2. Name the generating stations located along the Fleuve Saint-Laurent (St. Lawrence River).

   _____

   _____

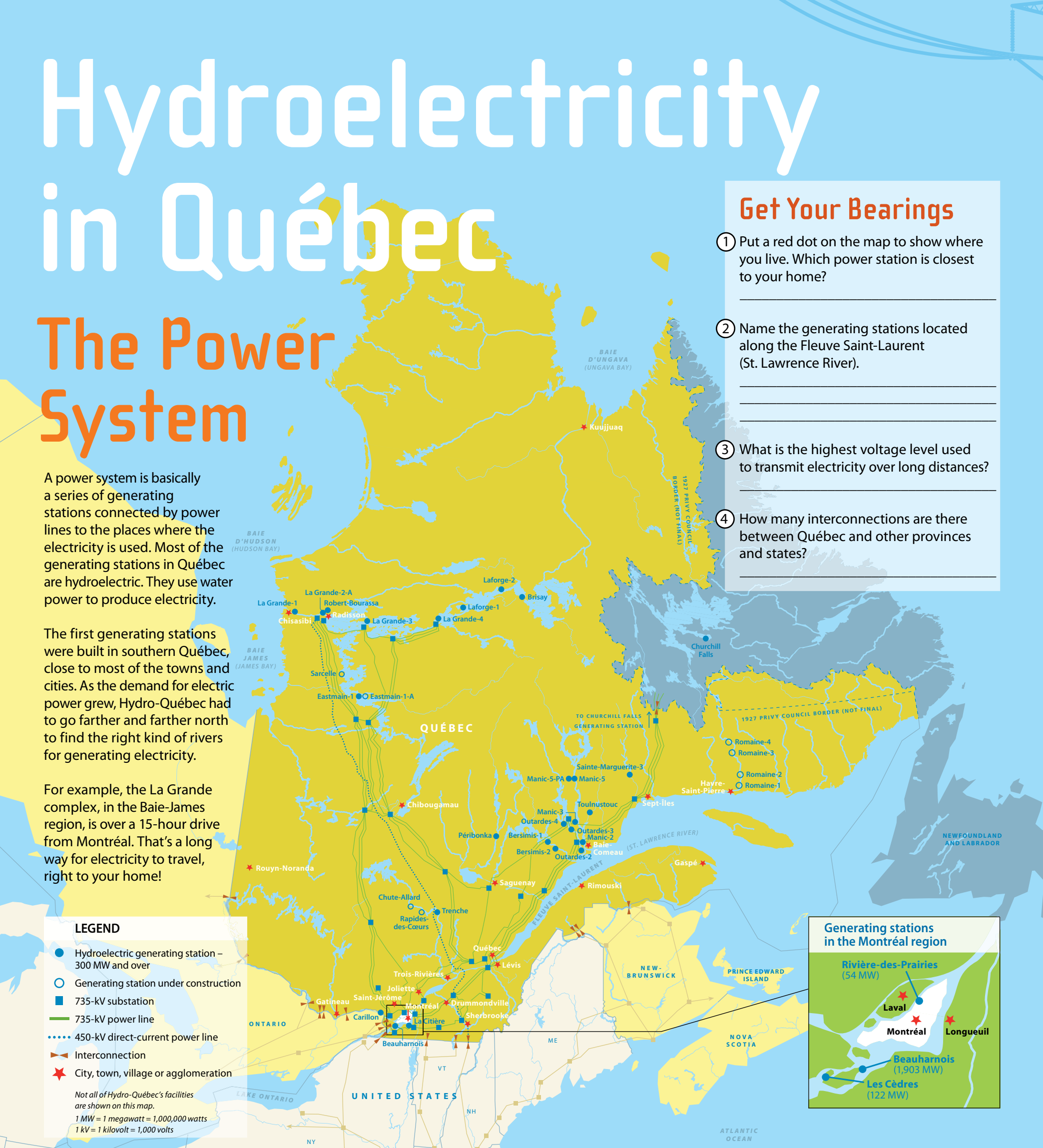
   _____

3. What is the highest voltage level used to transmit electricity over long distances?

   _____

4. How many interconnections are there between Québec and other provinces and states?

   _____



LEGEND

- Hydroelectric generating station – 300 MW and over
- Generating station under construction
- 735-kV substation
- 735-kV power line
- 450-kV direct-current power line
- Interconnection
- City, town, village or agglomeration

Not all of Hydro-Québec's facilities are shown on this map.

1 MW = 1 megawatt = 1,000,000 watts
1 kV = 1 kilovolt = 1,000 volts

A Variety of Energy Resources

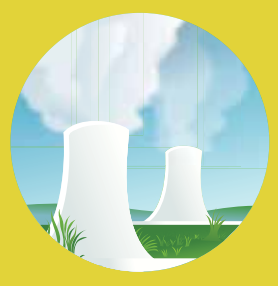
Various natural resources are sources of energy. Read the explanations on the facing page, then label each picture below and tick a box to show whether the resource is **renewable (R) or nonrenewable (NR)**.

_____ R☐NR☐

_____ R☐NR☐

_____ R☐NR☐

_____ R☐NR☐



_____ R☐NR☐

_____ R☐NR☐

_____ R☐NR☐

_____ R☐NR☐

Is it renewable?

R Some resources are **renewable**. They can be replaced by natural processes or by good management. In other words, they **can't** be used up.

NR Other resources are **nonrenewable**. There are only limited quantities of them and they **can** be used up.

Power Generation

"Guess what I found out when I was doing research for my science club? 'Hydro' comes from the Greek word for water. Now I know why we talk about hydroelectricity."
By Selina

Most of the electricity used in Québec is generated using water power. We're lucky we have so much water—it's a renewable resource! Plus, hydroelectric generation doesn't create pollution, so it helps in the fight against climate change. Awesome!

How electricity is generated

The first step is usually to build a **dam** to hold back the water and create a **reservoir**. (See the picture on the next page.) When the dam gates are opened, water rushes from the reservoir down through a **penstock** and into the power station. The penstock is like a slide that has just the right slope to give the water the force it needs to spin a **turbine**. The turbine's rotating shaft is connected to a **generator**, which converts the mechanical energy into electrical energy.

Gigantic!

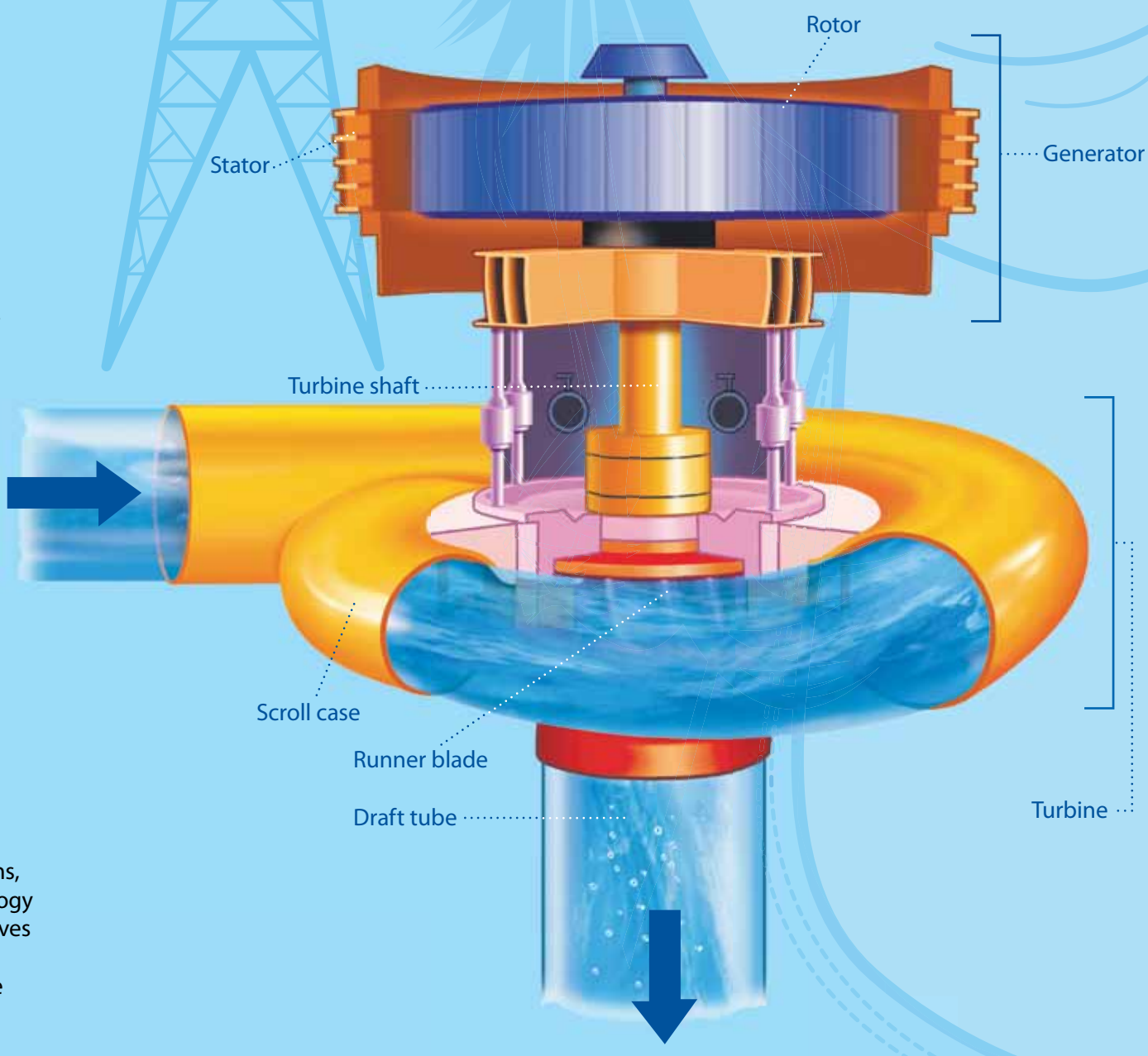
A typical Hydro-Québec turbine is about four metres across and two metres high. The biggest ones, like those used at La Grande-3 generating station in the Baie-James region, weigh 870 tonnes each. That's about as much as 290 elephants!

Power without the hydro

Resources other than water can be used to generate electricity. In thermal power stations, fossil fuels, nuclear fuel or geothermal technology are used to boil water. The steam created drives the turbines. Wind turbines are also used to generate electricity, and solar energy can be harnessed with various technologies.

Bon voyage!

Once the electricity has been generated, it flows through a switchyard that steps up, or raises, the voltage. Then it's ready to leave the power station and begin its long journey along **transmission lines**.



Fossil fuel

Fossil fuels (coal, oil, natural gas, propane) are formed in the Earth from the remains of dead plants and animals. The process takes millions of years. When these fuels are burned, they release energy, which can then be converted into electricity. However, the supply of fossil fuels is limited.

The Sun

We can use energy from the Sun for heating or convert it to electricity. This is called **solar power**.

Nuclear fuel

Splitting the core of atoms—called fission—frees a huge amount of energy in the form of heat. **Nuclear power plants** use this heat to generate electricity. Most plants use uranium as fuel because it is relatively easy to split the atoms of this metallic chemical element found in the Earth's crust.

Deep inside the Earth

Did you know that the Earth's **core** has a temperature similar to the Sun's surface? This heat is transferred to the Earth's **crust** (outermost layer) by the Earth's **mantle**, a thick rocky shell on which the continents move. **Geothermal energy** involves extracting heat stored in the Earth to generate electricity or, on a smaller scale, for home heating.

Biomass

Biomass is organic material that can provide energy in different forms. **Wood** has been long used for heating and cooking, and waste from sawmills is now used to generate electricity. In recent years, we've found more ways to use biomass. For example, we can capture **biogas** from manure or decomposing household waste to produce heat and electricity. Plants like corn and sugar cane can be transformed into **biofuel** for all kinds of vehicles.

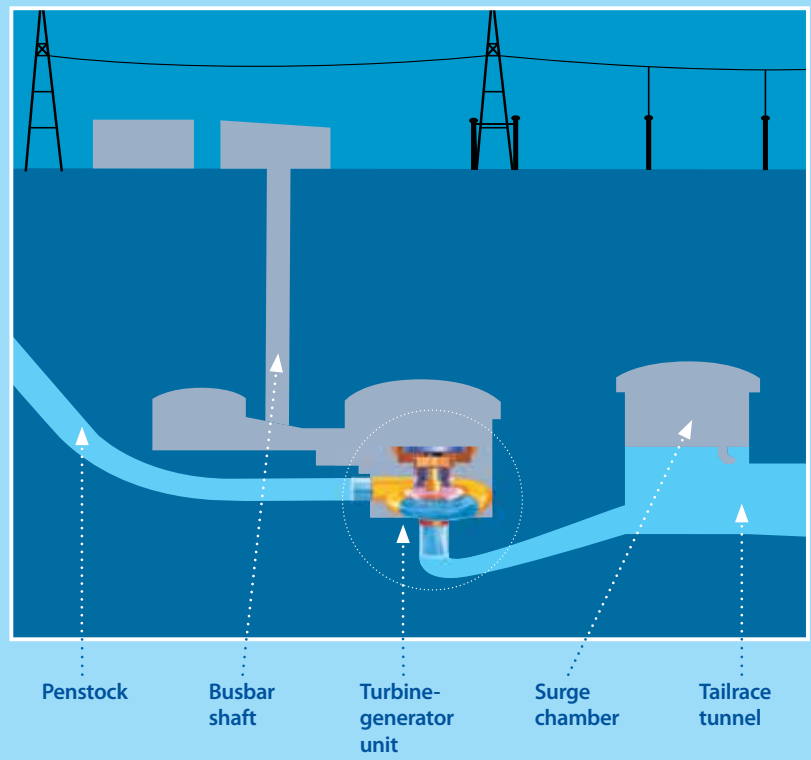
Water

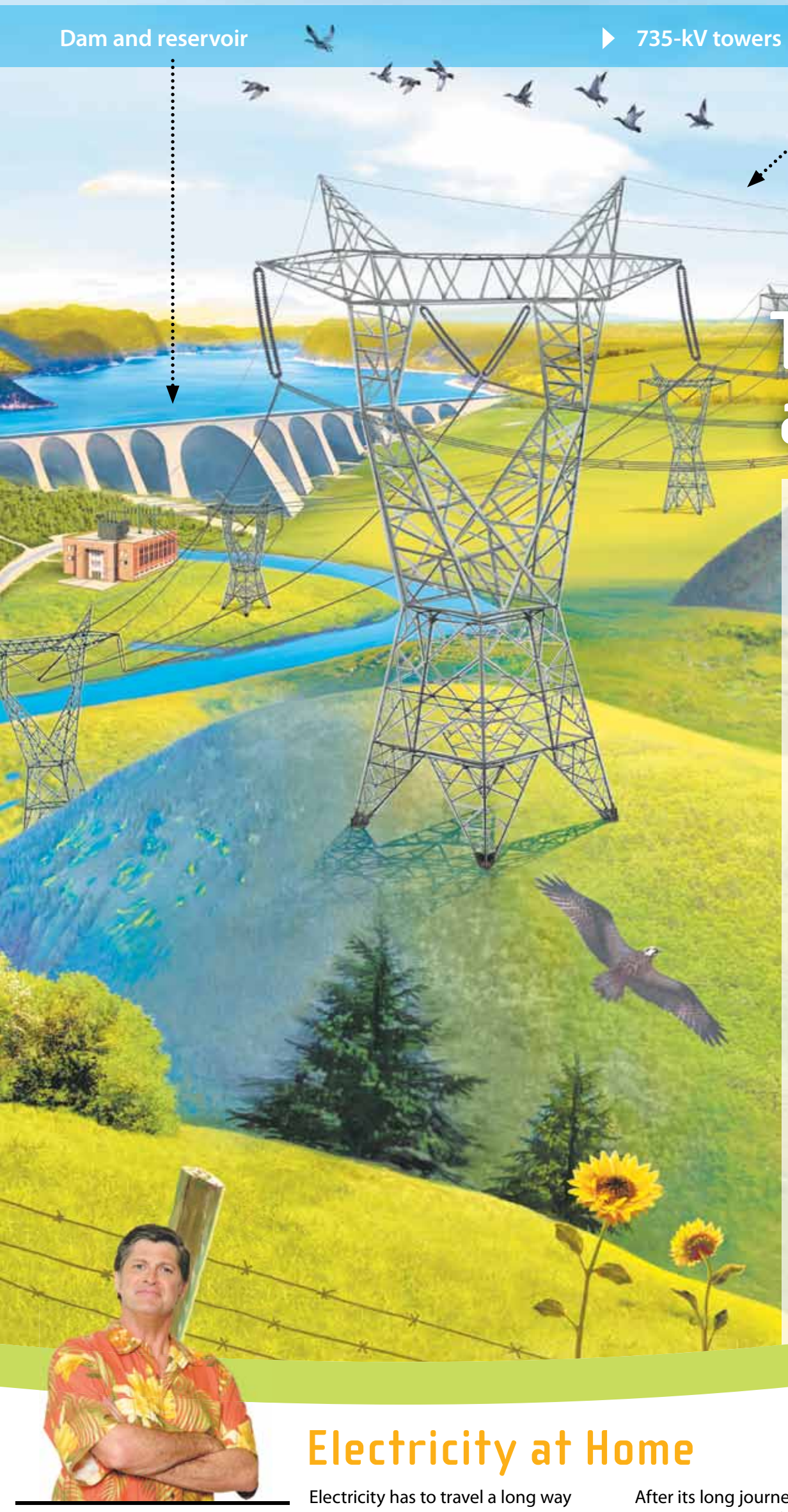
Water is a renewable resource and moving water is a clean source of mechanical energy. **Hydroelectric** power stations use the driving force of water—rivers, ocean tides and currents, and water from reservoirs—to turn giant turbines that generate electricity, or **hydroelectricity**.

Wind

Wind is air in motion, which can be harnessed to turn windmills or turbines. Today, **wind power** is mainly used to produce electricity.

When there isn't enough of a drop in level to give water the necessary driving force, the turbine is installed underground.





Transmission and Distribution:

How Electricity Gets to You

Think about that new sweater you just bought. It didn't get to your favorite store by magic! It was shipped to a warehouse from the factory where it was made, and from there it was trucked to your mall. Quite a trip! In the same way, electricity is generally produced far from your home and travels a long way—hundreds of kilometres—to reach you.

The power highway

That sweater of yours was popular this year. The factory sent out thousands in huge trucks that traveled along highways to your town. Electricity is also in demand, and Hydro-Québec sends out millions of kilowatts every year that travel along **high-voltage lines** suspended from **towers** to reach urban centres.

A few stops along the way

Your sweater was dropped off at a warehouse on the edge of your town and a smaller truck brought it to your local mall. Then you bought it and took it home in your car. Electric power also leaves the "highway" when it nears the city. At **source substations**, the voltage is stepped down, or lowered, and the power is sent off along **medium-voltage lines**. Closer to your home, **satellite substations** reduce the voltage again and supply **distribution lines**. Those are the lines you see on **utility poles** in your neighborhood.

End of the line

Transformers at the tops of poles drop the voltage one last time, to 240 volts, before the electricity enters your home. The big difference between the trip your sweater took and electricity's journey is transit time. Electricity travels at 300,000 kilometres per second, nearly the speed of light. Electricity is used almost as soon as it is generated!

"I have electricity all through my house, just like you. Have you ever wondered how it actually works? Well, this is your lucky day, because yours truly, André Mongeau, got the answers straight from Hydro-Québec! So pay attention and you might learn something. But if you only remember one thing, remember this—Better safe than sorry!"

By Mr. Mongeau

Electricity at Home

Electricity has to travel a long way through a complex power system to get to us. And most important, it has to be transmitted safely! Electricity doesn't flow through the towers themselves, just the overhead lines. And if lightning strikes, the **ground wire** strung along the top of the towers protects the lines.

No poles? Look down, way down!

Overhead lines aren't the only way to connect houses to the power system. If you don't see any utility poles around, especially in newer subdivisions, it means the lines are buried underground. Pretty clever, eh?

After its long journey from the power station, electricity finally makes its way into your home (and yes, mine, too!) through the **connection point** and the **meter**. The meter measures how much electricity you use, in kilowatthours. I'll bet you don't know what happens next.

Step by step

From the meter, the electricity travels to the **distribution panel**. From there, a number of individual circuits go to the outlets throughout your home. There are two types of circuits: 120-volt, which power small devices like toasters, and 240-volt, which power major appliances like stoves. (Which reminds me, I've got a great spaghetti sauce simmering right now. It smells fantastic!)

Safety first!

Every circuit has a **fuse** or **circuit breaker**, which protects the wires and reduces the risk of fire. But circuit breakers aren't enough. The **main switch** or **breaker** is usually located on or near the distribution panel. It can be used to cut power to the entire house if necessary. But even that isn't enough to keep your family safe. Everyone has a role to play in preventing accidents. Remember, when it comes to electricity, **safety** comes first!

120-kV towers

Power distribution

25-kV poles

Connection point

Supply point

Service entrance mast

Electricity meter

Distribution panel

A house is like a miniature distribution system

The circuits in your home are an extension of Québec's power system, and your home is like a miniature electrical distribution system.

The connection point is where the electricity from Hydro-Québec arrives. The distribution panel controls the power in your home kind of like a satellite substation. And wires bring current to every room in your home the same way that power lines carry electricity to houses in your neighborhood.

Power bar with surge protection

This protects electronic equipment (television sets, computers, and so on) from power surges by diverting extra electricity into the ground. Even though power bars like these have several outlets, it is best not to use them all.

Safety Around the

House

1

Look at this scene and find 17 dangerous situations that could have "shocking" results.

2

How many helium balloons can you find?

3

Find the following items: a utility pole, a transformer, an electrical outlet, a power line, five devices powered by electricity, a clown and a rooster.

What is an Electric SHOCK?

Always unplug the toaster before trying to remove any bread that's stuck. Never use a fork or a knife to get your toast out!

"Electricity plays a big part in our lives, you know. We use it every day for all kinds of stuff. We can't see it or smell it, so it's easy to forget how dangerous it can be. But nobody wants to get an electric shock, right?"
By Manolo

Getting to Know Electricity

To use electricity safely, we need to understand it. These pictures show how electricity is a lot like water. They'll help us get a good idea of how an electric shock can occur.

Water

In the circles on the left, you can see a **tap** and a **hose** with **water** flowing through it. What happens if there's a hole in the hose? That's right, the water leaks out and runs onto the ground.

Electricity

If you look at the circles on the right, you'll see that an **electrical outlet** can be compared to a tap. **Electrical current** flows through a **power cord** like water through a hose. And like water, electricity can escape and flow into the ground.

The differences

One difference is that electricity needs a **conductor** to act as a pathway between its source and the ground. The conductor can be a piece of metal, something wet, a liquid or even the human body, because we are over 60% water. But the big difference is that you won't hurt yourself if you touch a leaky hose. Unfortunately, electrical current can **seriously damage** our bodies.

Never use a clothes hanger or any other metal object to fish a sock out from behind your washer or dryer. Pull the machine away from the wall instead.

Water + electricity = danger! Never use electrical appliances near water, and never leave a power cord in a pool of water. In the bathroom, special outlets protected by a ground-fault circuit interrupter must be used. This device keeps us safe by shutting off power when an appliance or cord plugged into the outlet comes in contact with water.

Danger—Electric SHOCK Can Kill!

Electricity does a tremendous amount of work. But because it's such a powerful and invisible force, we need to be very careful with it. People are injured or killed every year by electricity.

A frayed power cord, a puddle of water on your bathroom floor, a toaster too close to your kitchen sink, too many plugs in one outlet … These and many other ordinary situations could cause an electric shock that could seriously injure or even kill you.

What is an electric shock?

An electric shock is the effect of electrical energy flowing through a human (or animal) body.

Why don't birds get shocks?

A bird that lands on an overhead wire will not get electrocuted if it is not in contact at the same time with another electric wire and if it doesn't allow electricity to reach the ground. But we have our feet on the ground—or on a roof or a ladder touching the ground. So, if we or the metal ladder we're using touch a live bare wire, electricity will use us as a path to the ground!

What happens during an electric shock?

When an electric current passes through the human body, it heats the tissue along its path. If enough heat is generated, the tissue will burn. The burns are like those caused by fire, except they can be deep inside, and therefore very serious.

Two people who receive an electric shock from the same source, at the same voltage, will not necessarily suffer the same effects. The severity of a shock depends on many things, including your natural resistance, how wet or thick your skin is and what you're wearing. For instance, if your hands are dry and you're wearing rubber-soled shoes, you might get a mild shock. If your hands are wet and you're standing barefoot in a puddle of water, the shock is likely to be much more severe, and may even kill you. Death caused by electric shock is called electrocution (a combination of "electricity" and "execution").

Possible effects of an electric shock

- Unpleasant tingling sensation
- Jolts of pain
- Loss of muscle control
- Muscle contractions strong enough to break your bones
- Burns, especially where the electricity entered and left your body
- Heart or lungs stop working

Shock severity

A shock's severity depends on three main factors:

- *Current strength*
- *Current's pathway* through the body
- *How long* a person is in contact with current

Many people believe that an electric current has to be very **strong** to kill somebody. But a current of only 5 milliamperes can block the signals between your brain and your muscles, causing your heart to stop beating properly and preventing you from breathing. To give you an idea of what that means, the 60-watt lightbulb in your desk lamp draws a current of about 500 milliamperes.

There are two other important factors. The first is the **path** the current takes through your body. The damage is more likely to be severe if the current passes through your heart, brain or other internal organs. The second is **how long** you're in contact with the source of the current. The longer the contact, the greater the shock. Unfortunately, your muscles contract when you get a shock. If your hands are touching a live wire, you might not be able to let go. You'll stay in contact with the electric current until someone shuts off the power.

Prevention

Prevention is the best way to protect yourself from injury. You can prevent and avoid shocks by following safety rules and not taking risks like those shown on these pages.

Some causes of electric shock

- Faulty appliances
- Children and pets chewing on power cords
- Children poking metal objects into outlets
- Damaged or frayed cords or extensions
- Electrical appliances in contact with water
- Faulty or worn household wiring
- Fallen power lines

Dangerous Situations

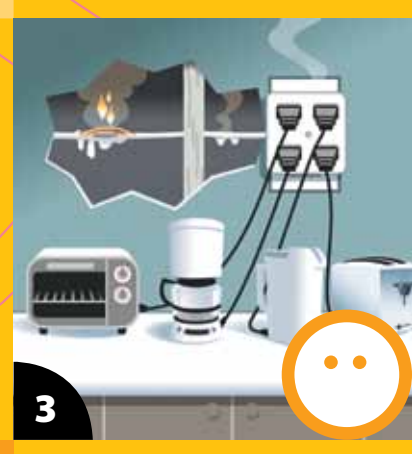
- Fill in the circles so that there's a ☺ beside every safe situation and a ☹ beside every dangerous situation.
- Underline *True* or *False* to indicate what you think of each of the six statements on the board.

Start

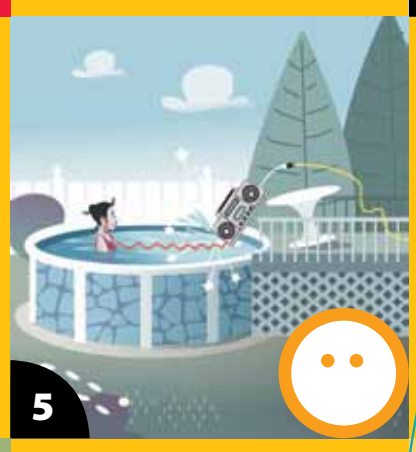
1 You should pull on the plug, not the cord, to unplug an electrical appliance. **True or false?**

2

3



5



6 You should unplug a kettle, iron or coffee maker before filling it with water. **True or false?**

9

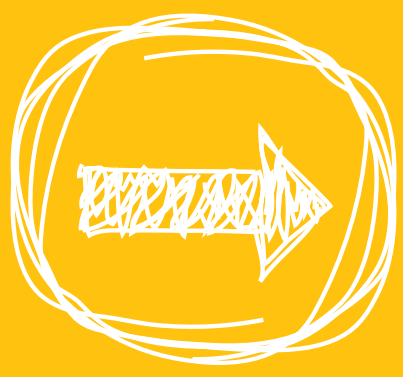
10 Power cords should be kept out of the reach of children. **True or false?**

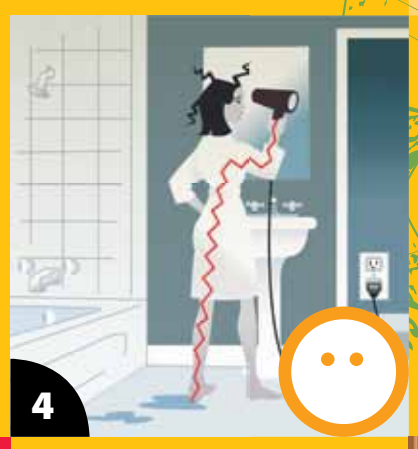
11

13

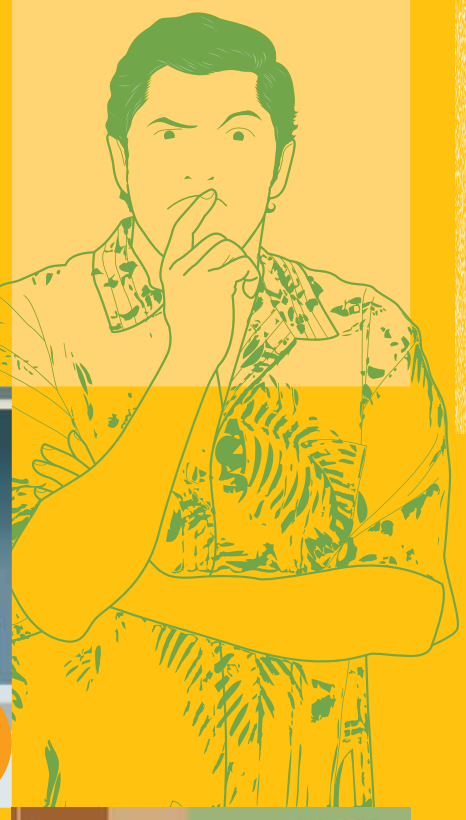
14

15 You should unplug an electrical appliance before fixing it, and unplug a lamp before changing the lightbulb. **True or false?**





4



Danger can be avoided by not overloading electrical outlets, unplugging appliances that aren't in use and using power bars with surge protection. True or false?

7

8

It's dangerous to plug in an appliance in a bathroom if the outlet doesn't have a ground-fault circuit interrupter. True or false?

12

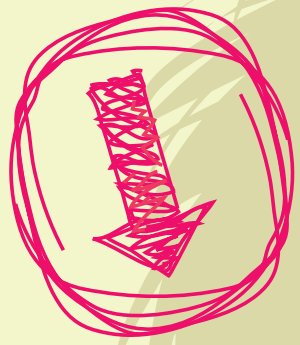
16

17

Drivers need to know what the traffic signs mean. Because we use electricity every day, we need to know what electrical safety signs mean.

Do you know what these signs mean?

Do you know what this symbol stands for?



Why is it dangerous to carry a ladder that's taller than you are?
ANSWER: _____

Why is it dangerous to set up your radio near the swimming pool or the bathtub?
ANSWER: _____

RIDDLE: Figure out the three syllables and put them together.
My first is not too tall in height.
My second's a title for a knight.
My third's a collection of objects, a set. My whole's a hazard, when electronics get wet.
ANSWER: _____

TRUE OR FALSE

1. Selina won't get a shock if she's wearing shoes with rubber soles.

TRUE **FALSE**

2. Mr. Mongeau should unplug the lamp before replacing the burned-out lightbulb.

TRUE **FALSE**

3. If an electrical outlet catches fire, Manolo should throw water on it.

TRUE **FALSE**

4. Mr. Mongeau should tell the children it's dangerous to play with water near an electrical outlet or a switch.

TRUE **FALSE**

5. Selina shouldn't use a fork to get the toast out of a plugged-in toaster.

TRUE **FALSE**

6. It's okay for Manolo to use an electric mower on a wet lawn.

TRUE **FALSE**

7. Selina's computer equipment is plugged into a power bar with surge protection. She doesn't have to worry about overloading a circuit.

TRUE **FALSE**

8. Mr. Mongeau says the amount of current required to light a 60-watt bulb is enough to kill someone.

TRUE **FALSE**

9. If Manolo's sound system has a three-prong plug, he has to plug it into a three-prong outlet.

TRUE **FALSE**

10. It's completely safe for Mr. Mongeau to fill his steam iron with water without unplugging it first.

TRUE **FALSE**

11. It's not dangerous for Selina to use a blow dryer in the bathroom because the outlet has a ground-fault circuit interrupter.

TRUE **FALSE**

12. If Selina gets a shock, its severity may depend on how wet her skin is.

TRUE **FALSE**

13. Mr. Mongeau is unscrewing a 20-watt lightbulb with wet hands. This is much less dangerous than unscrewing a 100-watt lightbulb with wet hands.

TRUE **FALSE**

14. If Manolo sees a girl holding a live wire and receiving an electric shock, he should try to pry her fingers off the wire.

TRUE **FALSE**

15. It's safer for Selina to hang a picture from a self-adhesive hook than from a nail.

TRUE **FALSE**

16. Mr. Mongeau should run power cords under the carpet so that he doesn't trip over them.

TRUE **FALSE**

17. Manolo has noticed that birds on power lines don't get electric shocks. That's because the lines are insulated.

TRUE **FALSE**

18. If a live power line falls on Manolo's car and there's no risk of a fire, he'll be safe if he stays in the car.

TRUE **FALSE**

19. Mr. Mongeau's hedge trimmer has a three-prong plug so that it doesn't come out of the outlet too easily.

TRUE **FALSE**

20. Selina believes that during a storm, a tree standing alone in the middle of a field is more likely to be hit by lightning than a tree in the city.

TRUE **FALSE**

www.hydroquebec.com/learning

2009G1155A-1 150M
ISBN 978-2-550-56719-6

Hydro Québec

100%