TEACHER'S PACKAGE

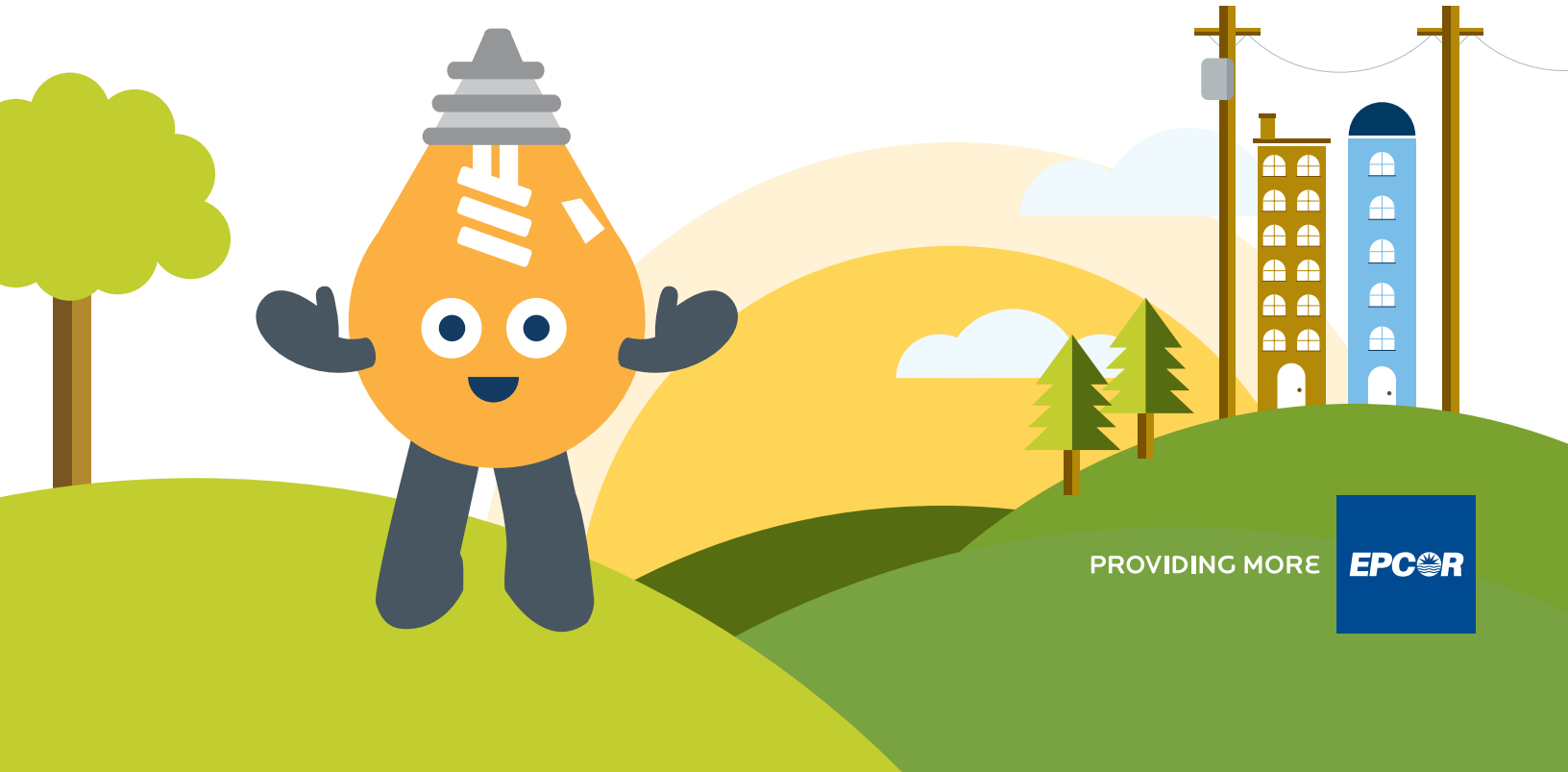
MODULE 1
EPCOR ELECTRICITY 101

Grade 5 Science – Topic A: Electricity and Magnetism

Specific Learner Expectations:

- Students will recognize and appreciate the potential dangers involved in using sources of electrical currents.
- Understand that household electrical currents are potentially dangerous and not a suitable source for experimentation.
- Students will understand that short circuits may cause wires to heat up.
- Demonstrate that a continuous loop of conducting material is needed for uninterrupted flow of current in a circuit.
- Demonstrate electrical conductors – materials that allow electricity to flow through them, and insulators – materials that do not allow electricity to flow through them.
- Recognize and demonstrate that some materials, including resistors are partial conductors of electricity.

Cross curricular competencies: Manage information, identify and solve complex problems, think critically.

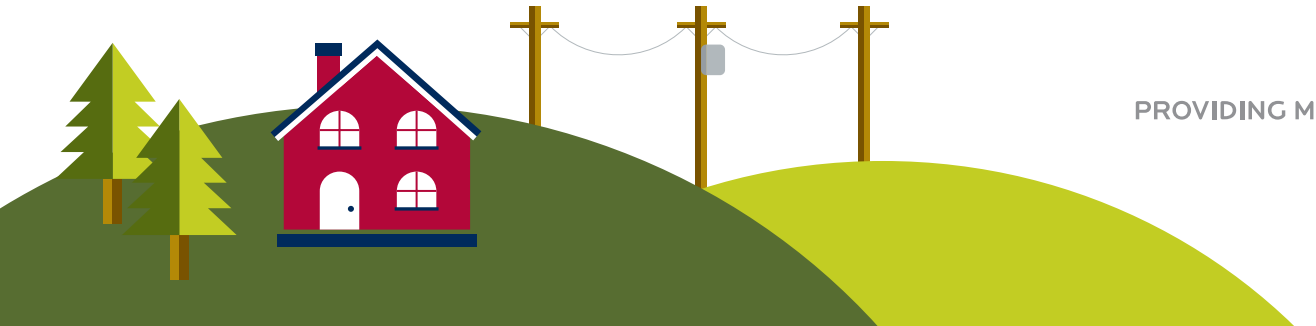


SLIDE NO.	SUGGESTED SPEAKING NOTES
1	· Today we're going to learn about electricity. · In Edmonton, EPCOR makes sure electricity travels safely so that you can use it at home and school. EPCOR has been around for over 125 years and they also make sure the water from our taps is safe to drink.
2	· We're going to talk about an electrical circuit, how it works and how to be safe around electricity. · Electricity is a very wonderful AND powerful resource. But we have to do our part to understand and to respect it. If not, we risk it becoming a danger, instead of something to help and enjoy our lives with. · Who here has used electricity today? · What did you use it for? **! Have children raise their hands and then ask a couple of them what they used it for.**
3	· Now, can you imagine how you would be doing those things if we didn't have electricity? · How would you read a book? Would you be able to play video games? How would your mom or dad cook dinner?
4	· What is electricity? · Electricity is extremely useful and extremely powerful. Because of this we wanted to make sure you understand the role of electricity and how to use it wisely and safely. · It is a form of energy that we use to power machines and electrical devices. · You can see electricity in nature, like during a storm when there is lightning. · Can you think of a form of electricity that can be made quickly and sometimes accidentally? **! Have children raise their hands and guess.**

SLIDE NO.	SUGGESTED SPEAKING NOTES
5	· The answer is static electricity. · It's made by rubbing two objects together, like a balloon against your hair and having your hair stand up. · In the winter you might see or feel sparks when you take off your toque.
6	· Everything around us that has a mass and takes up space is called **matter.** · Apple, person, air, desk, pencil, etc. · All matter has an **electric charge.** **! Solicit responses from students for additional examples.**
7	· The smallest part of matter is an **atom,** and the smallest part of an atom is an **electron.** · Electrons are so tiny you can't even see them with a microscope but they have a very important job – they are the main ingredients needed for making electricity. · Let's see what happens when there is electricity present.
8	· Here is an animation of what happens inside an atom when electricity is present! We've slowed things down a little so you can see what's happening. · When you use an electric appliance – that is what is happening in the wires! · We call this an **electrical current.**
9	· Let's brainstorm things that use electricity in school and at home. **! Have students list items and then have pre-determined graphics appear after they've named a few to see if they captured them all.**
10	· A **circuit** is what we call the path or flow of electricity. · Electrons flow through a circuit, like the one shown here. · The battery acts as a power source where electrons enter the circuit and there are wires for the electricity to safely flow through to illuminate the light. As long as the light is on we know there is an electrical current flowing through the circuit. Let's check it out. **! Play animation on Slide 11**

SLIDE NO.	SUGGESTED SPEAKING NOTES
11	· When you flip the light switch into the on position, it completes or closes the circuit and the light turns on. · When you put the switch into the off position, it disconnects or opens the circuit. · Normally when you flip the switch for a light, the light comes on immediately. This animation slows things down so that you can see what's happening on the circuit. · (They don't call it the speed of light for nothing!)
12	· Let's look at what happens when the wire becomes disconnected from the battery. **! Play animation** · When a circuit is broken, electricity cannot travel to its destination. It doesn't matter where the break occurs – the result will be the same. The circuit is broken and power won't reach its destination. · When there is a power outage in your neighbourhood, it means there has been a break in the electrical circuit and EPCOR crews are working hard find the break in the circuit and fix it safely.
13	· When the circuit is broken, wires can get so hot they can actually cause fires and even explosions. · **Short circuits** happen when wires are frayed and exposed, and pose a MAJOR risk of electrical fire. · Short circuits occur when two or more wires touch that are not supposed to come into contact. This can result in a very high **current** flowing through the **circuit.** · What do you think we should do with cords that are frayed? **! Solicit responses from students for their thoughts.** · The best and safest thing to do is stop using that cord, have an adult safely remove it from the outlet. You can take it to the ECO center and replace it with a new one. · If you touch the spot with the short circuit there is a possibility that you can get burnt or depending on the amount of current, it could even kill you.

SLIDE NO.	SUGGESTED SPEAKING NOTES
14	· Like we've talked about, electrons travel on a path without beginning or end, continuing to loop forever and ever. Electrons need a **conductor** to flow through. · In the circuit we just saw the conductor is the wire connecting the switch to the light to the battery back to the switch. · Short circuits get in the way of us being able to use and enjoy electricity, and they can be very dangerous. But we can be friends with conductors, because conductors are the tickets to an uninterrupted flow of current in a circuit. They allow our main ingredient, electrons, to flow through. They basically give electrons a 'hall pass' and make a way for them to keep going/flowing. · Can you give me some examples of conductors? **! Solicit responses from students for their thoughts. Using white board or large poster board, write down correct student responses. *You can call on a volunteer writer from the class*** **Hints you can provide: Conductors include most types of metal, copper, silver, aluminum, gold etc. & water, people, animals, trees. Real examples from 'their world' would be awesome – like, jewellery, baseball bats (wooden & aluminum), wooden ruler, steel scissors, and so on.**
15	· **Insulators** are the opposite of conductors – they RESIST the flow of electrons so much that no current flows through it. It's like they give electrons an RT (responsibility tutorial) or detention, or time-out. · Insulators make electrons stop what they normally and naturally do. Can you think of examples of insulators? **! Solicit student responses for insulators.** **Examples: glass (windows, the outer part of a light bulb), porcelain, plastic, and rubber.** **! If students are having difficulty coming up with answers - have them look at your desk, for example, and just list all the conductors and insulators in the 2 columns on the large poster paper.** **! Another fun option might be to divide class into two teams and have a timed contest to see which team can list the most items in the columns. Compare answers**



SLIDE NO.	SUGGESTED SPEAKING NOTES
16	· Electricity has a mind of its own, and will always take the path of least resistance to the ground. It is very powerful and very fast, and we can control the direction of electricity through the use of conductors and insulators. · Because our bodies are at least 60% water – people are great conductors. · This is why when EPCOR crews and electricians work with electricity they use Personal Protective Equipment made to resist the flow of electricity – so they don't become conductors. · The shirts and coveralls these gentlemen are wearing made of special material so that if they come in contact with electricity, the clothes do not act as conductors. They wear leather gloves on top of thick rubber gloves to protect their hands. Both the rubber and the leather act as insulators. · EPCOR also uses resistors on power poles to prevent electricity from escaping down the pole to the ground. You can see one in this photo, here: *(Point to the ceramic object at the top of the photo, you can see the power line coming down behind it.)* · They even use these orange insulators when they are working in order to prevent accidental contact with the power line. *(There is one in the bottom right of the photo and behind the hands of the worker on the right.)*
17	· **Resistors** reduce the amount of electricity that flows through a circuit. · Did you know this is exactly how the volume dials on a stereo works with speakers? · When you turn the dial down, it reduces the amount of electricity that gets to the speaker, making the music you are listening to softer. **! Have on hand a portable radio and demonstrate the role of resistors by turning the volume up and down.** · Another common resistor you may have around home is a dimmer switch. · Let's see what happens to the light in the circuit when we move the light switch up and down. **! Play animation** **Other examples would be dimmer switches on lights, and heating function in toasters when you select different settings like darker and lighter, bread vs. bagel.**

SLIDE NO.	SUGGESTED SPEAKING NOTES
18	· What happened when we moved the dimmer all the way to the top of the switch? ! **Solicit responses from the class.** · That's right, the light got brighter than when it was in the middle. By moving the switch closer to the on position, more electricity was able to flow through to the light bulb.
19	· The transformers do exactly as their name suggests, they transform – or change – the very high powered or high voltage electricity into usable electricity for your home. · Let's take a look at some transformers you might see around the neighbourhood.
20	· Have you seen these around the city? ! **Have students raise their hands in response.** · These are called substations and once electricity travels from a generation station, it gets to a substation and large transformers lower the voltage to one safe to travel in neighbourhoods. · To stay safe, it's important that you stay outside the fences around the substations.
21	· How many of you have seen the green transformer boxes like this in your neighbourhood or around the school? What about these gray transformers on power poles? ! **Have students raise their hands in response.** · It's important to keep a safe distance from transformers and not to play on or around them. · When a power outage occurs, EPCOR staff may need to easily access to the transformer boxes to correct the problem and restore power back to your neighbourhood.
22	· Let's see how this all works together to get electricity to your house and to our school. ! **Play video in provided link.**

TEACHER'S PACKAGE

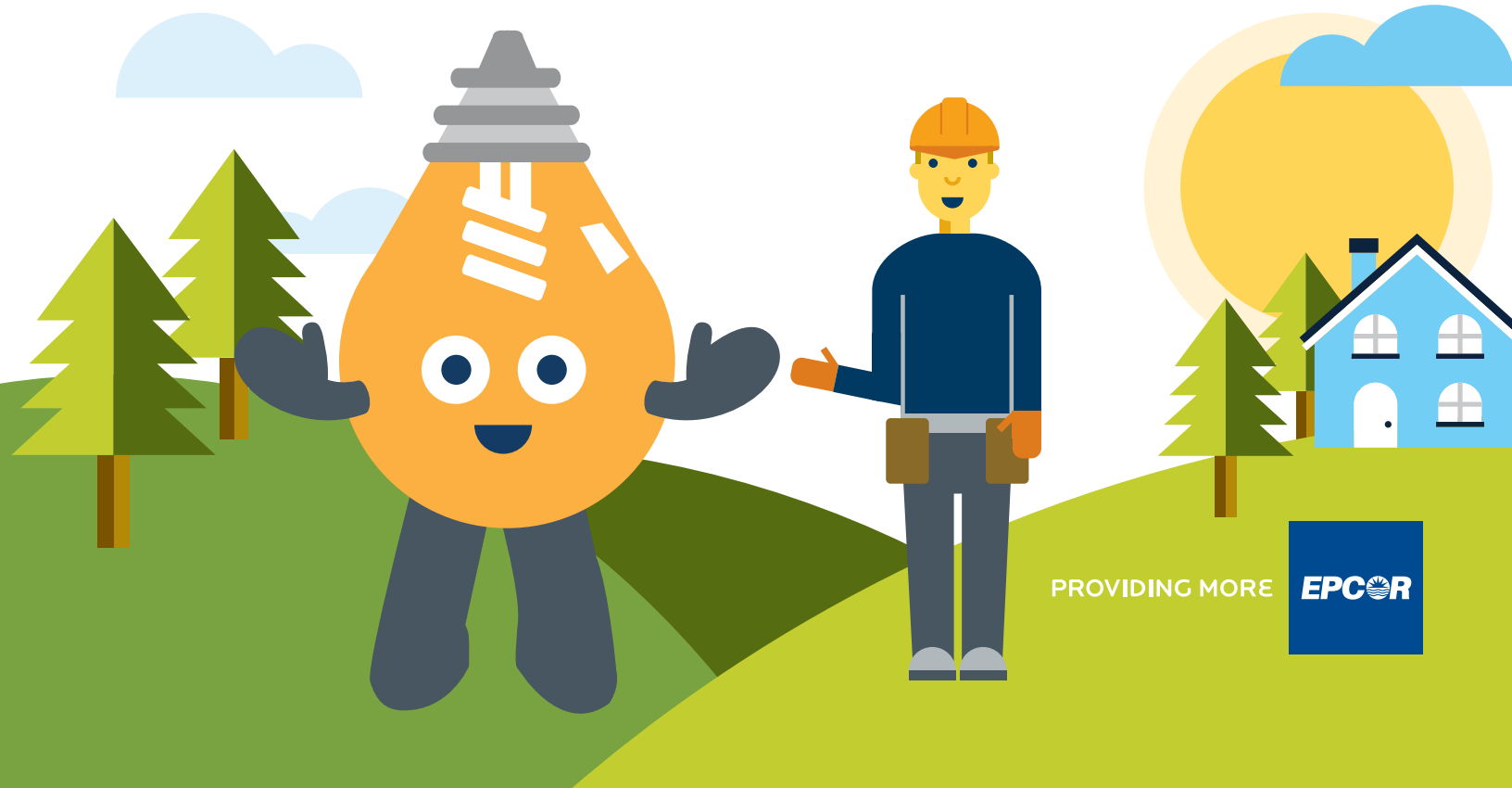
MODULE 2
ELECTRICITY SAFETY AND MEASUREMENT

Grade 5 Science – Topic A: Electricity and Magnetism

Specific Learner Expectations:

- Students will recognize and appreciate the potential dangers involved in using sources of electrical currents.
- Understand that household electrical currents are potentially dangerous and not a suitable source for experimentation.
- Students will understand that short circuits may cause wires to heat up.
- Recognize that the amount of electricity we use in our homes is measured in kilowatt hours.

Cross curricular competencies: Manage information, identify and solve complex problems, think critically.

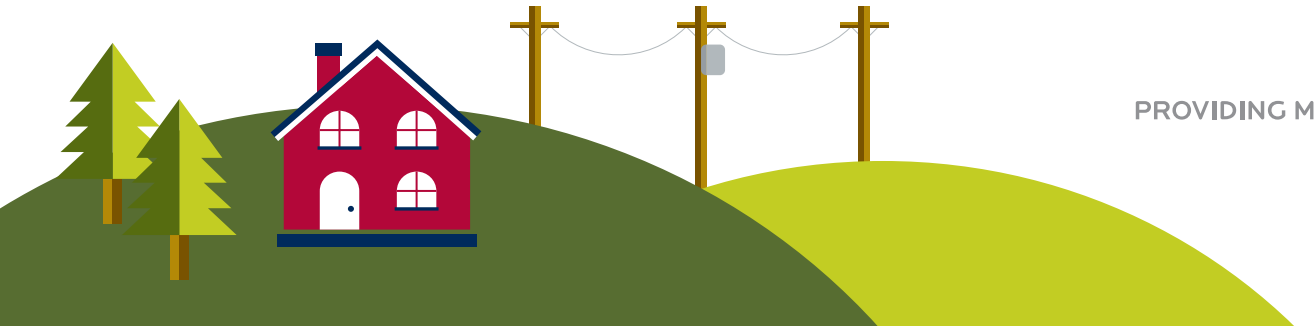


SLIDE NO.	SUGGESTED SPEAKING NOTES
1	· In the last module, we learned about how an electrical circuit works and how it travels around the city. · Now we're going to focus on how we can be safe by treating it with respect and how power is measured.
2	· Remember, electricity flows through a circuit and all power lines are part of a circuit. · Circuits have a power source, conductors, and insulators; and can have resistors and transformers.
3	· Do you remember what we discussed about short circuits? ! **Solicit responses from the class.** · When the plastic coating on the wire becomes damaged and the wires are exposed, this can be a safety risk. The exposed wires can potentially shock you or start a fire. · What do we say we should do with cords that are frayed like this? ! **Solicit responses from the class.** · The best and safest thing to do is stop using that cord, have an adult safely remove it from the outlet. You can take it to the ECO center and replace it with a new one.
4	· Some people use adaptors to increase the number of appliances they can plug into a wall socket, like the one seen here. · However, although there is space to plug in six appliances, this does not mean it is always safe to do so. · In your own home, be careful not to overload your plugins or extension cords. Plugging too many devices requiring electricity can exceed the maximum amount of current for the circuit and can cause the circuit to overheat and potentially cause a fire. · Also, don't stick objects into outlets. This can lead to electric shock, which means that an electric current is passing through your body! · Remember, being a conductor of electricity is no fun!

SLIDE NO.	SUGGESTED SPEAKING NOTES
5	• Does anyone know why the electrical outlets in the bathroom and by the kitchen sink are different than the ones in the rest of the house? *(Point to buttons between the plugins).* • Power and water should not mix, EVER! • These outlets are specially designed so that if the circuit gets overloaded the circuit opens and stops the flow of electricity. Once you unplug the electronics that are causing the issue, you have to push the reset button on the outlet. • Part of the reason why this type of outlets exist is because water can act as a conductor and helps to carry electricity. If the two mix, like if a radio fell into the kitchen sink while you are washing dishes or your mom left her hair dryer plugged in and it accidentally fell into a bathtub full of water. • In both instances, the water would become electrified and it can be very dangerous and potentially deadly. These special breakers are designed to break the circuit if electricity comes into contact with water. • Similarly, if an electronic device is resting on the edge of a sink, you should not run the water!
6	• Let's talk about electrical safety outside now. • What safety rules do you remember when we talked about substations? • When you are out playing with your friends, stay away from electrical substations that look like this. • If you see signs like this then you know that there is electrical equipment that is dangerous and you shouldn't go inside. **If you lose a ball or Frisbee over the fence, call EPCOR to let them know and they can retrieve it for you the next time they are there.**
7	• What do you remember about transformers? **! Solicit responses from the class.** • That's right, they transform the power so that it is safe to use in our homes. Also, we're not supposed to play on or around them. • If there is a power outage in your neighbourhood, EPCOR employees might need to access the transformer to restore power, so we should also make sure they have room to work around it. This means we shouldn't plant or build anything close by.

SLIDE NO.	SUGGESTED SPEAKING NOTES
8	· Remember when I said that electricity wants to get to the ground as fast as it can? When it gets there, electricity travels THROUGH the ground in waves that lose power as they spread. So the further away you are, the safer you are. **! Measure out 10 meters in the class room to give students the perspective of how far that is. This is close to the length of a school bus.**
9	· Can you see what is wrong with this picture? **(Branch fell on line).** **! Solicit responses from the class.** · Storms can cause downed power lines. Sometimes this is because a tree branch has fallen on top of the line. A downed power lines means that a circuit has been broken. · This is a very dangerous situation. Please do not go near downed power lines! Stay at least 10 metres away and call 911 or EPCOR and we will make sure it gets repaired safely.
10	· If you see a vehicle come in contact with electrical equipment like this transformer or a power line, make sure you and everyone else stays at least 10 metres away. · If a power line or transformer comes into contact with the vehicle you and your parents are in, remain in the vehicle and call 911. · You are not a direct path to ground while you are inside the car and you act like a bird on the power line, floating in the air with no direct path to the ground. An EPCOR employee will come and turn off electricity to the area and assist you to safety.

SLIDE NO.	SUGGESTED SPEAKING NOTES
11	· If you find yourself in an unsafe situation, and are very close to, or right in an area, where there has been an electrical circuit break, it is really important that you remember how to safely remove yourself. · Please remember that you cannot lift one of your feet/legs without the other! You have to jump clear of your vehicle. Keep your feet close together, landing on the ground with both feet at the same time. Do not touch the vehicle and the ground at the same time and don't return to, or reach back into, the vehicle to get anything you may have forgotten. · Once on the ground, shuffle your feet keeping both feet on the ground at all times until you are at least 10 metres away from your vehicle. · Call 911 and EPCOR will come to make everything safe again. · Keep everyone else 10 metres away so they stay safe too. **! Demonstrate and have students practice!** **A video demonstrating how to exit the vehicle can be found here: https://www.youtube.com/watch?v=HtfkypKXr-I**
12	· Boys and girls, every month, your family pays money for the electricity, water and natural gas that you all have used/consumed at home. It's easy to turn on a switch, but there is a cost each time you do. · The billing unit used by electric utilities like EPCOR is called the Kilowatt hour or kWh. If you look at a power bill you will see these letters. This measure of electric energy is equivalent to a power consumption of 1,000 watts for 1 hour. **! Write these figures down as you are speaking to give the students a visual and to help them track this line of thought.** · In Canada, all energy and fuel that is sold need to be measured by a Measurement Canada approved meter. This is true for your power meter, natural gas meter, the pumps at the gas station and many more.



SLIDE NO.	SUGGESTED SPEAKING NOTES
13	· Here is what a power meter looks like in Edmonton. How many of you have seen this on the outside of your home? **! Have students raise their hands.** · It has several display screens, but this one – the one that starts in DEL is the one that shows you the total amount of electricity used at you home. · DEL stands for power that is DELivered to the site from the electricity grid or circuit. · Every month, your electricity retailer takes this total amount of energy and subtracts the reading from the previous month. This tells them how much electricity your family has used during that time. · So if your power meter reading for this month was 2,152 kWh and your reading last month was 1,476 kWh. How much electricity did your family use? **! Write these figures down as you are speaking to give the students a visual.** **! Have them solve the problem 2,152-1,476 kWh = 676 kWh.** · If you have solar panels on your home, the electricity produced by the panels is recorded on the power meter too. It shows up in the REC display. REC stands for Received to the electricity grid from the site, your home.
14	· Let's look at how this shows up on an EPCOR power bill. · On the front page of your bill, there is a graph which shows your family how this month's energy consumption in kilowatt hours compares to the same month last year as well as the previous month. · On the second page, you will see the meter readings from your home listed. As well as the cost of electricity for that month per kilowatt hour. · Can you guess how much electricity the average Albertan household uses per month in kilowatt hours? **! Have students guess and write them down.** · Well, you're pretty close – the answer is 600 kWh/month. When it is warm in the summer time and brighter out during the day people can use less energy. And when it is colder out during the winter and darker out, people tend to use more electricity to keep their homes bright.

SLIDE NO.	SUGGESTED SPEAKING NOTES

15	• Energy efficiency helps Canadians:
	  • Save energy
	  • Lower utility bills
	  • Reduce our impact on the environment.
	• In Canada, you will see two logos that help determine energy efficiency: EnerGuide and Energy Star.
	• EnerGuide is the official mark of the Government of Canada for its energy performance rating and labeling program for key consumer items—houses, light-duty vehicles, and certain energy-using products.
	• The information provided by EnerGuide allows consumers to compare different models with confidence. The data may be a rating number based on a standard measure or a verified average
	of energy consumption.
	• EnerGuide works in concert with Canada's Energy Efficiency Regulations and the ENERGY STAR® Initiative in Canada to promote energy efficiency in Canada.
	Source: nrcan.gc.ca

16	• EnerGuide labels are mandatory for clothes dryers, clothes washers (including integrated washer-dryers), dishwashers, freezers, electric ranges, cooktops, ovens, refrigerators, refrigerator-freezers, and air conditioners.
	• There are four things displayed on an Energy efficiency label that help consumers understand its power usage:
	  • Annual energy consumption of the model in kilowatt hours (kWh)
	  • Energy consumption indicator, which positions the model compared with the most efficient and least efficient models in the same class
	  • Type and capacity of models that make up this class
	  • The model number
	Cont'd on next page.

SLIDE NO.	SUGGESTED SPEAKING NOTES
16	Cont'd · Can you help find this information on the refrigerator label displayed here? **! Solicit responses from the class.** · This label shows the appliance uses 300 kWh of electricity each year. And the shaded bar or consumption indicator shows you how the energy usage of this make and model of appliance compares to others being sold in Canada. · As you can see by this indicator, this particular appliance does fairly well and is on par with others that use the least amount of energy. · It is a Type 3 model of 16.5 – 18.4 cubic feet capacity. · The model number for this example is 00000.
17	· Remember, electricity is an incredible resource that we can all enjoy when we treat it with respect and stay safe. · It's also important to use it wisely by being as energy efficient as we are able. · Can you think of ways that you are or can save energy around your house or the school? **! Solicit responses from the class and have a volunteer write them on the board.** **Examples include; making sure the fridge or freezer door is closed tight, turning lights off when you leave the room, shut down your computer and video game consoles, etc.**
18	Final slide.