ATCO

POWER Safe

An education resource about electricity for Grade 5

atco.com

Introduction

At ATCO, the safety of our employees and everyone who uses electricity is the most important thing to us. Safety education is one way we can help ensure that everyone knows how to be safe around electricity.

This resource was built with the help of Alberta teachers. Its main objective is to teach students about electricity and the safety hazards of interacting with it.

ATCO Electric supports the efficient use of electricity through customer information and education programs. Visit **www.atco.com** or call **1-800-668-2248** (toll free) for more energy management materials.

Table of Contents

BACKGROUND INFORMATION

Background information is provided for each lesson. The materials list in each activity refers to the background information that will be useful. The terms highlighted in bold in the background information are defined in the glossary.

ACTIVITIES

The lesson plans and answer keys include information on how to complete each activity. The learning outcomes, time and materials needed, advance preparation, procedure and extension activities are also provided.

The activities in this kit are not all required. However, it is recommended that the activities are completed in the order provided.

Activity 1: Electrons in Motion

Time: 3 hours
Specific/General Learner Outcomes 5-5 (1, 4, 5, 6, 7, 10) and 5-6 (2, 3, 4, 7)

Activity 2: Electrical Hazards

Time: Part A – 30 minutes, Part B – 45 minutes
Specific/General Learner Outcomes 5-5 (1)

Activity 3: Home Safety Inspection

Time: 30 minutes with take-home assignment
Specific/General Learner Outcomes 5-5 (1)

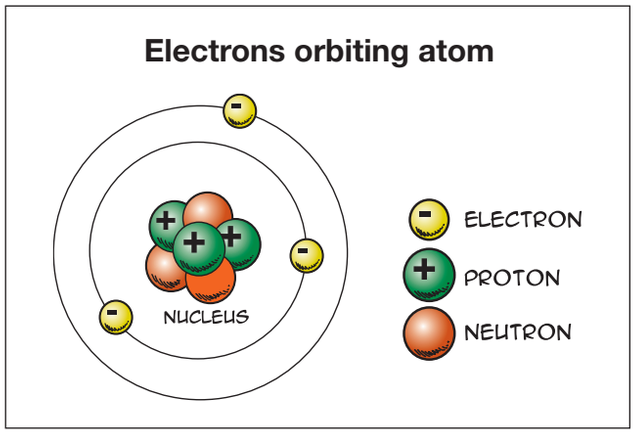
Glossary

A glossary provides the definitions of some words used in the kit.
These are written for students as well as for teachers

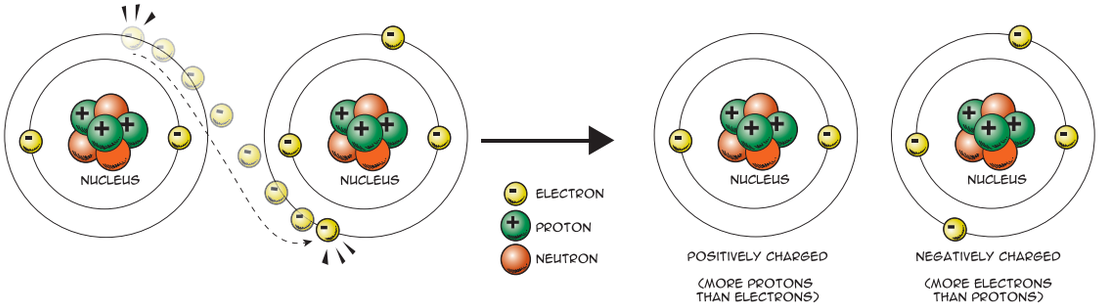
Background Information

1. The Flow of Electricity

All matter is made up of atoms. Atoms are made up of tiny particles called **electrons, protons** and **neutrons**. Protons and neutrons are contained within the middle of the atom, while the electrons orbit around them. Electrons have a negative charge, protons have a positive charge and neutrons have no charge (neutral). When the charge is neutral, the number of protons is equal to the number of electrons.



Electrons that orbit the farthest away from the middle of the atom can break free and travel to other atoms. In an **electrically neutral** atom, the number of electrons is equal to the number of protons. If an electron were to leave this atom, it would have more protons than electrons; therefore, the atom would be **positively charged**. If an electron were to join this atom's orbit instead, there would be more electrons than protons; therefore, the atom would be **negatively charged**.



Electricity is the flow of electrons from atom to atom in one direction, like water flowing through a pipe. When electrons move in one direction at the same time, an electric current forms. This flow of electrons contains energy that we can use. The path through which these electrons flow is called an **electric circuit**. Electricity is always looking for a route into the earth, also called **path to ground**. Electricity will travel through the easiest available path to the ground.

1.1 Insulators

Materials through which electricity does not travel well are called **insulators**. Glass, rubber and porcelain are good insulators because electricity doesn't move easily through them. Some materials, such as dry wood, car tires and air, normally act as insulators at lower voltages; however, at high voltages they will conduct electricity.

1.2 Conductors

There are many materials through which electricity can travel very easily. These are called **conductors**. The best conductors are metals such as copper and aluminum. Electric wire is usually made of copper. Water also conducts electricity well. This is why it is important to be careful when we use electric appliances near water.

1.3 Resistors

Resistors are devices that reduce the flow of electrons in an electric circuit. In a resistor, electrons can still flow through the object (like a conductor), however, the resistor reduces the number of electrons that can flow through the conducting material. This reduction is due to limited space for electron movement. This resistance can be harnessed into forms of energy. For example, in a simple circuit with a battery connected to a light bulb, the light bulb acts a resistor. The current still flows through the light bulb; however, the electrons are resisted within the light bulb coil – this resistance produces heat and light.

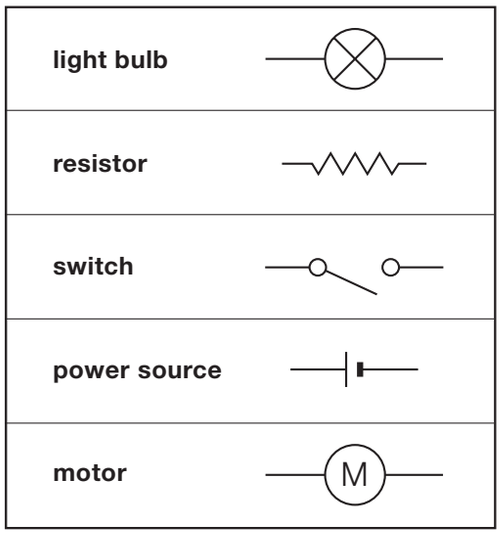
Resistance Simulation

To help students better understand the concept of electrical resistance, visit **http://phet.colorado.edu/en/simulation/battery-resistor-circuit** for an interactive simulation.

To illustrate another example of resistance, contrast the amount of energy a person would need to run through water as opposed to running through air. The resistance would be much higher as a person tries to run through water. In this instance, the water acts as the resistor.

When working with electricity, people use symbols to demonstrate parts of an electric circuit. The following are the most common symbols used:

Electrical Symbols



1.4 Voltage

Voltage is the pressure of the electricity in a power line, like water pressure in a hose. Voltage is measured in **volts** (V). All home electric equipment in North America requires either 120 or 240 volts of electricity.

1.5 Amperage

Amperage measures the electric current and number of electrons that flows through a wire. Since the voltage is like the water pressure in a hose, the amperage would be equivalent to the rate of flow of the water. It measures the electric current. The nozzle on the hose can be opened just a bit, producing a small spray, or opened up wide, producing a much larger spray. Some electric appliances, such as light bulbs, require small amperage to operate. Larger devices, such as an electric hair dryer, require much higher amperage. The units used for amperage are called amperes (**'amps'**) or milliamperes (**'milliamps'**). There are 1,000 milliamps for every 1 amp. Most home circuits are rated at 15,000 milliamps or 15 amps. As shown by the table on the next page, as little as 50 milliamps can be fatal.

Amperage	Effect
1 to 8 milliamps	Feel sensation of shock, though not painful
8 to 15 milliamps	Painful shock
15 to 20 milliamps	Painful shock, loss of muscle control
20 to 50 milliamps	Severe muscle contractions
50 to 200 milliamps	Heart failure is possible
Over 200 milliamps	Severe burns and heart failure

2. Safety Devices in Home Electric Systems

It is important that everyone respects electricity. Electricity safety involves avoiding situations where people become a path allowing electricity to travel through them to get to the ground.

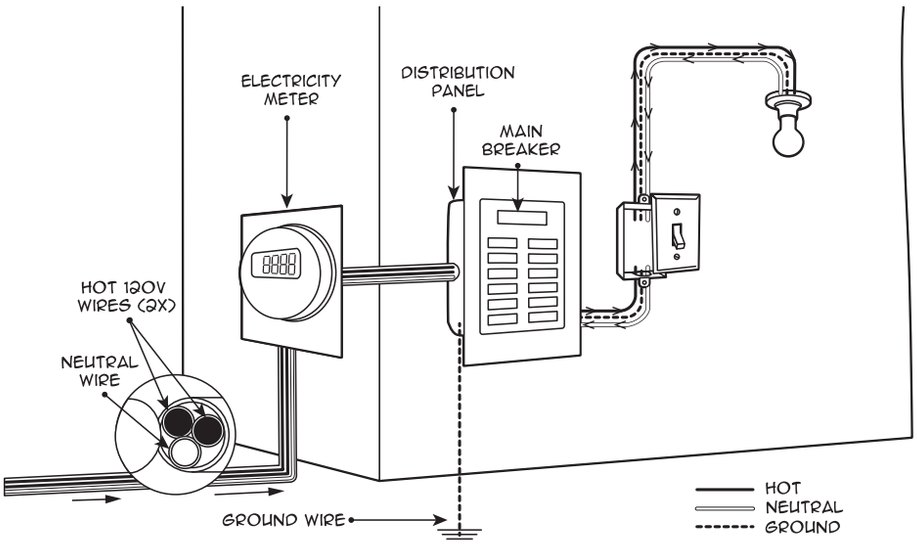
Three safety features built into home electric systems are:

- insulated wires
- ground wires
- circuit breakers

2.1 Insulated Wires

All electric wires in homes are insulated, so no one can receive a shock by touching a wire. Most electric wiring in houses includes three small wires:

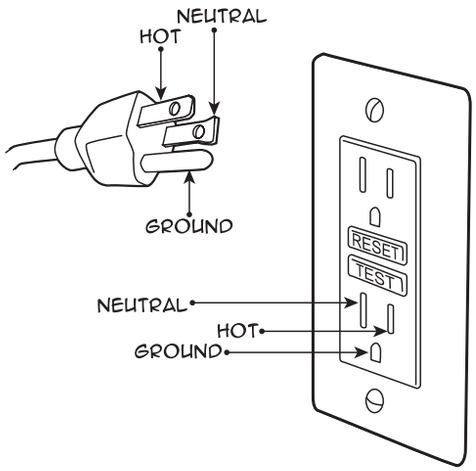
- "Hot" wires (black or red) carry electricity from the distribution panel to electrical devices.
- Neutral wires (white) return electricity from electrical devices to the distribution panel.
- Ground wires (green or bare copper wire) allow electricity a path to ground.



These wires are insulated from each other. The hot and neutral wires form the electric circuits for each light, outlet or appliance to which they are connected. The hot wire carries electricity from the generating station. The neutral and ground wires are connected together and provide a return path for the electricity outside the house.

2.2 Ground Wires

The purpose of the **ground wire** is to carry electricity to the ground if anything goes wrong with the electric circuits in the house. The ground wire, like the neutral wire, is connected to the ground outside of the house. Ground wires are also connected to outlets, lights and metal electric boxes. If there is a **short circuit** or if any appliance malfunctions, the electricity goes safely through the ground wire into the ground instead of causing shocks or fires.



Many electric appliances have plugs with three prongs: one to connect to the hot wire, one to the neutral and the third to connect to the ground. This is a **grounded circuit**. In this case, if a hot wire contacted the metal parts of that appliance, those parts would become energized and therefore, a hazard. This hazard is mitigated by the fact that the circuit breaker should sense the fault and trip the breaker to disrupt the circuit. However, if a person were to touch the energized metal parts of that appliance before the breaker is tripped, they would receive a shock. On the other hand, some electrical appliances have plugs with only two prongs. These plugs are missing the ground wire, so the circuit is ungrounded. In this case, if a hot wire touched a conducting material and a person touched the material, the person would become the path to ground.

2.3 Circuit Breakers

A **circuit breaker** is a switch that connects the electric wire that enters your house with the hot wire in each electric circuit within the house. The **distribution panel** found in the basement of most houses, or in a closet in newer appartments, contains several circuit breakers. A circuit breaker is designed to stop the flow of electricity to an appliance if too much current flows through a circuit. Without a circuit breaker, the flow of too much current can cause the wires to overheat, which could start a fire. With a circuit breaker this would not happen. For example, if a hot wire became frayed and touched a metal piece inside a lamp, the electric current would immediately move from the lamp through the ground wire. This creates a short circuit, tripping the circuit breaker interrupting the flow of current.

3. Electricity Distribution

3.1 Electricity Grid

All electricity flows through electric circuits that begin at generating stations, travel through power lines and end up in homes, offices and industries. The **electric grid** is a network of wires that transports the electricity from the generator to the customer. In Alberta, this grid covers all of the heavily settled parts of the province and connects to Saskatchewan and British Columbia. The grid is also connected to the United States through British Columbia.

3.2 Transmission, Distribution and Service Lines

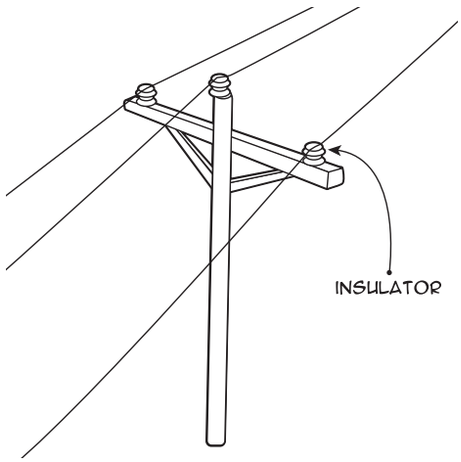
ATCO uses two types of power lines – transmission and distribution. High voltage electricity runs through **transmission lines** that are typically supported by high steel, concrete or

wooden transmission towers. These are generally used for electricity that travels long distances. Wooden poles are typically used to support lower voltage **distribution lines**.

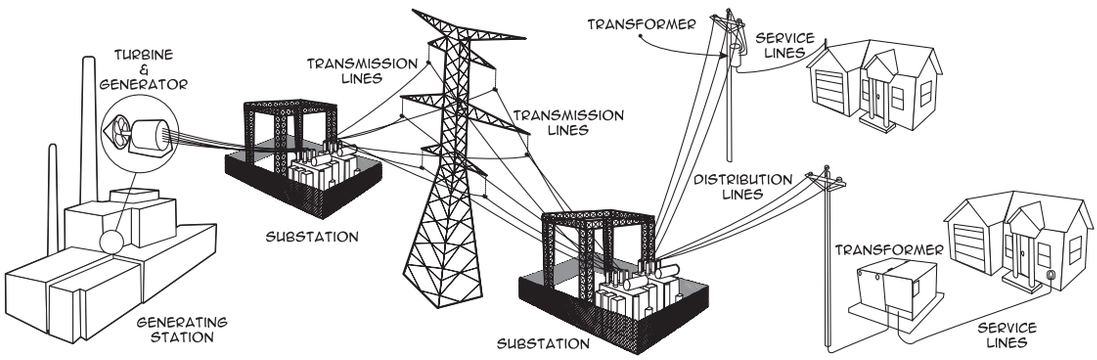
Service lines take the electricity from the small transformers in your neighbourhood or at the top of a distribution pole and carry it to your house. Overhead service lines to your house or business are insulated.

3.3 Transformers and Substations

ATCO uses **transformers** to control the voltage of electricity. After electricity is generated at a generating station, it flows into a **substation** with a transformer. This 'step-up' transformer converts the electricity to high voltages (e.g., between 72,000 and 500,000 volts). The high voltage pushes the electricity through transmission lines around the province. However, homes require only a 240 volt (2 x 120 volt) service and most industries require voltages less than 1,000 volts; therefore, the voltage needs to be dropped, or stepped down. The high voltage electricity flows through the transmission lines to a **substation**. At this point, the electricity goes through another transformer, although this time it is a 'step-down' transformer that greatly reduces the voltage. From here the electricity travels through distribution lines to a final, smaller transformer, which transforms the electricity to the required service voltage. These transformers can often be seen near the top of wooden power poles or as grey or green metal boxes on the ground in your neighbourhood. The electricity is then delivered through service lines to homes.



High voltage overhead power lines are NOT insulated, because the insulation decreases the efficiency of the transfer of electric energy. However, these lines are suspended high above the ground and land development is not allowed in the immediate vicinity. At the top of transmission or distribution support structures, insulators ensure the lines are protected from making contact with the support structures. This is to make sure electricity cannot travel down through the structure (e.g., tower or pole) to the ground. Lower voltage distribution lines are sometimes buried. When buried, those lines need insulation to prevent electricity from leaving the power line. Nevertheless, all power lines should be considered dangerous.



The ground is used as part of the electric system. Electricity looks for a path to ground throughout the circuit. Part of ATCO's job is to keep electricity away from the ground until it is delivered to customers and used. The electricity will arrive where it is needed unless some conducting material touches the wires along the way and provides a path for the electricity to get to the ground.

Three electric wires enter each house from the final line transformer: two 120-volt hot wires carry electricity and one neutral wire provides the return path to ground. While most appliances need 120 volts, the second hot wire is needed for larger appliances that use 240 volts, such as electric stoves and dryers. These three wires go to the electric distribution panel in the home.

3.4 Electricity Load

The amount of electricity generated varies, depending on how much customers need. The amount that is required all the time is called the **base load**. Coal-fired electric generators are constantly used to generate the base load of electricity. The main reason to use coal-fired electric generators is they are the most economic. These generators are the least expensive to operate, and take a long time to start up; therefore, they are kept on all the time.

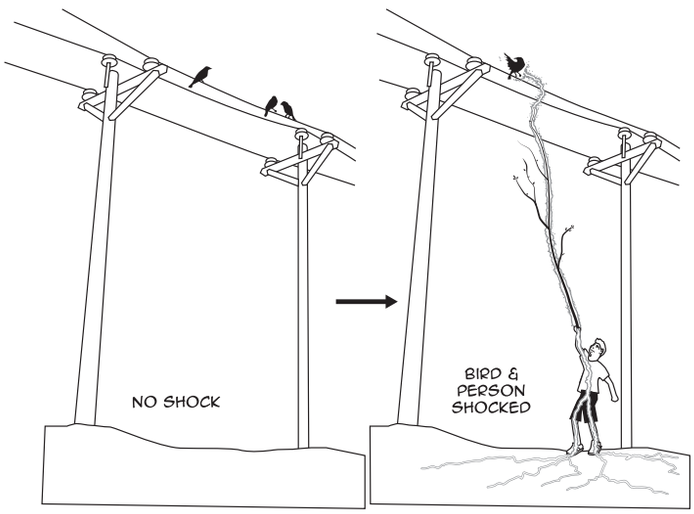
Sometimes Albertans need more electricity over and above the base load. The time when Albertans need the most electricity is called the **peak load**. Hydroelectric and natural gas generating units can be turned on very quickly, so they are used to supply the peak demand. Peak load is usually from 6 am to 9 am and then again from 5:30 pm to 8:30 pm.

4. Electricity Safety

Electricity is very dangerous because the human body is an excellent conductor. Since our bodies consist of about 70 per cent water, electricity travels through us very easily. While most people recognize that high voltage electricity in a transmission line can kill a person, few realize that more people in North America die from lower voltage home electricity accidents than higher voltage accidents. Everyone needs to learn how to live safely with electricity, both outdoors and indoors.

4.1 Electricity Safety Outdoors

Outdoor wires should never be touched by anything, particularly anything connected to the ground. For example, birds can sit safely on wires because the bird is not creating a path for electricity to flow to the ground. If a person standing on the ground or touching a transmission tower poked a stick at a bird sitting on an electric wire, both the bird and the person would become part of the path to the ground and receive a shock and possibly be killed.



Common outdoor hazards include:

- ***Climbing power poles.*** No part of a transmission tower or distribution pole should be considered safe. If a person touches the overhead wire while on the pole or tower, the person becomes part of the path to ground and will receive a shock and possibly be killed.

- ***Playing near transformers or substations.*** While all equipment is very well grounded, short circuits between the wires in a substation may occur. Any exposed equipment and wires should be considered energized, or hot, and dangerous. A person who gets too close to the equipment or wires can be in great danger. If a ball or toy lands in a substation – don't go in! Call ATCO to remove it.

- ***Kites becoming tangled in overhead wires.*** Kite strings, especially if wet, conduct electricity. The person holding the kite would be part of the path to ground.

- ***Trees.*** If tree branches are touching electric wires, the moisture and sap in the tree will conduct electricity. Someone who touches the tree could become the path to ground because they are a better conductor. This will result in the person getting shocked and possibly killed.

- ***Aluminum ladders and scaffolding.*** All metals are excellent conductors of electricity. Many people moving aluminum ladders and scaffolds have become the path to ground.

- ***Using ungrounded or frayed cords outdoors.*** If the ground is damp or the cord strays near water, the person using the ungrounded or frayed cord is in danger. Even in indoor situations, the person may become part of the electric circuit.

- ***Power lines on the ground.*** Assume power lines lying on the ground are energized. Do not go near them. Stay back at least 10 metres. Call ATCO Electric and tell them about the situation. If possible, watch the site and warn other people about the potential danger.

- ***Digging.*** Before digging, all underground utility facilities must be identified. Visit Albertaonecall.com or call at 1-800-242-3447.

4.2 Electricity Safety at Home and at School

ATCO ensures that electricity is delivered to houses and schools safely. Electricians install outlets and light switches so there will be no accidents. However, people can be hurt or killed by electricity in homes and schools by becoming part of the path to ground. Electricity can also cause house fires.

Common indoor hazards include:

- ***Overloading an outlet or a circuit.*** When too much electricity is moving through a circuit, the wire can heat up and start a fire.

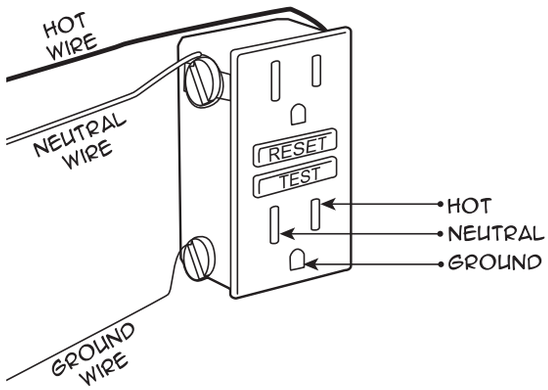
- ***Repairing or cleaning appliances or tools that are still plugged in.*** One potentially fatal example is using a metal knife to dig out a piece of toast stuck in the toaster.

- ***Frayed or worn electric cords.*** If the insulation between the hot wire and the neutral or ground wires wears away and the lines touch, a short circuit occurs. This could cause a fire. A person touching a frayed or worn cord could receive a shock.

- ***Sticking objects or toys into outlets.*** Use outlet covers on exposed outlets within the reach of small children.

- ***Using appliances with wet hands or close to a sink or bathtub.*** Since water is an excellent conductor, this can cause electric shocks or short circuits.

For additional safety, all bathroom and outdoor outlets (within 1 metre of water) should be equipped with ground fault circuit interrupters (GFCI). These GFCI's are designed to detect leaking ground current. If a ground current leak is sensed, the circuit opens and stops the electric current. Outlets with a GFCI have a test and reset button to test the GFCI. Plug in an appliance and press test. The appliance should not turn on. Remember to press the reset button to reactivate the GFCI.



5. Responding to Electricity Emergencies

5.1 Electrical Fires

Fires caused by short circuits in homes are extremely dangerous. If the electricity is still on, do not use water to put out the fire. As water is a good conductor, this will just allow the electricity to spread out and the fire will expand. Turn the power off at the home distribution panel. Use a "C" or "BC" rated dry chemical or carbon dioxide fire extinguisher.

5.2 Lightning Safety

Lightning is electrical energy that builds up as storm clouds develop. Lightning is extremely dangerous. At any given moment there are nearly 2,000 thunderstorms occurring over the earth's surface. Lightning strikes the earth 100 times each second. A lightning bolt may carry a current of 200,000 amps of electricity, thousands of times more than what is required to kill a person.

Like most electric charges, lightning is looking for the easiest path to the ground, so lightning safety involves avoiding situations where you could become a path to ground. The safest place to be during a storm is inside. If you are in an open area, go to a low place such as a ravine or valley and squat but do not lie down. Stay away from metal objects like farm equipment, motorcycles, bicycles and golf carts. Get out of, off and away from open water.

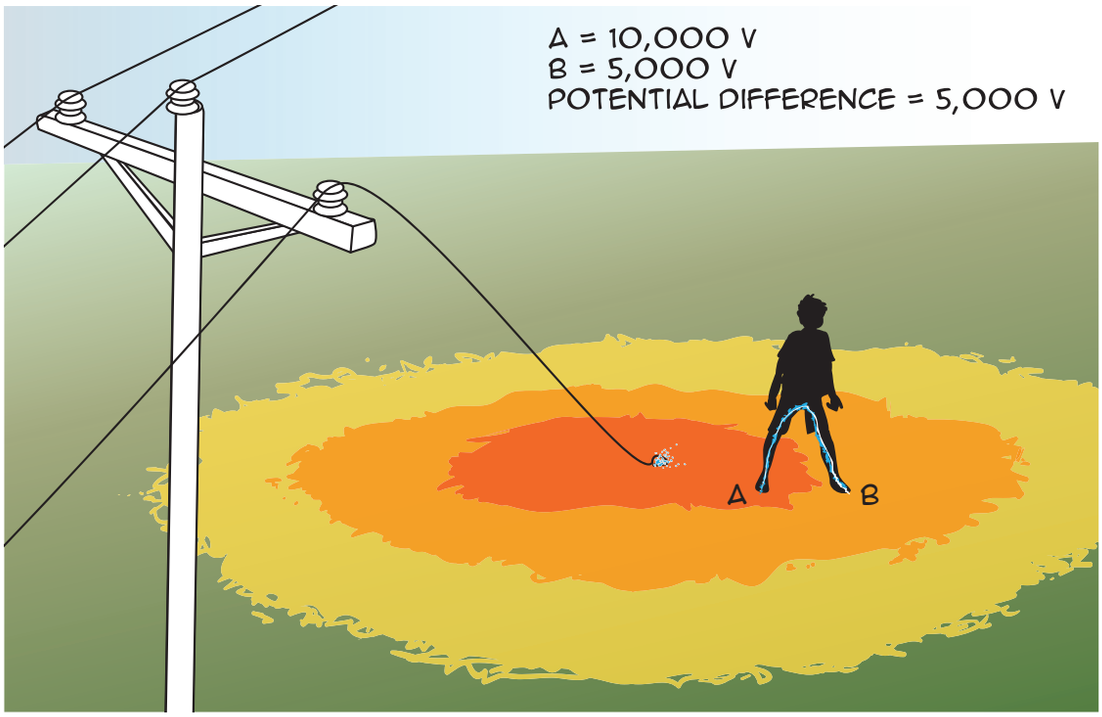
5.3 Vehicle Collisions with Power Poles

Occasionally a vehicle collides with a power pole and a power line falls onto the vehicle. If this ever happens to you, remember that electricity is flowing through the vehicle and to the ground. When you are inside the vehicle you are safe because you are not connected to ground. This is true for all makes and models of vehicles (e.g., truck, electric car). If possible, the vehicle should be moved so the wire falls clear. However, anyone outside the vehicle is in danger.

If you must get out immediately due to a fire, you should jump from the vehicle keeping your feet together. Do NOT touch the vehicle and the ground at the same time because you will be the path to ground and get shocked. Once clear of the vehicle, shuffle away never allowing the heel of one foot to move beyond the toe of the other, or hop with both feet together to a minimum distance of 10 m. People outside the vehicle should stay at least 10 m away. The best thing to do is to call ATCO, the police and an ambulance. Someone should stay at the site to warn others to stay at least 10 m away from the vehicle.

5.4 Step Potential

When electricity enters the ground the voltage is highest at the contact point and gradually decreases away from that point. This is like the ripples that form when a pebble is dropped into water. The pebble creates the strongest ripple closest to the point of contact and as these ripples spread out they lose strength. For example, if a power line were to fall at your feet, there would be a difference in voltage between the foot closest to the source of electricity and the foot farther away. This voltage difference between your feet is called **step potential**. The danger with step potential is that electricity wants to travel from a higher voltage to a lower voltage so it spreads out. Since a human body conducts electricity better than the ground, the foot closest to the contact point will act as an entry for the electricity to run up your leg and down the other back to ground. This may result in serious injury. When removing yourself from the situation, follow the 'shuffle or hop, don't step' rule.



If electric wires are knocked down during an accident or in a storm, assume that the wires are still energized. Everyone should stay at least 10 m away from the wires. ATCO should be contacted to turn the electricity off. The line is safe only when an ATCO employee or emergency responder indicates that it has been turned off.

It is extremely dangerous to try and move a high voltage wire without proper protective equipment. Even items that you think may have a high insulation value, such as a dry wooden stick, may conduct enough electricity to injure the rescuer. When a person has been injured by electricity, the most important task is to ensure that a second person does not become a victim by being a path to ground. A person who has received an electric shock and is lying on the ground may still be part of the path to ground. No one should be closer than 10 m from the victim before the source of electricity has been identified and the power turned off by ATCO. When it is confirmed that the power is turned off, medical treatment can begin.

An electric shock can often cause the heart to stop. A shock may also cause all the muscles to contract, which may fracture bones. High voltage often causes very serious burns. All electric burns must be treated by a doctor, as more tissue may be burned beneath the skin.

5.5 Click Before You Dig

Alberta One-Call is the number to call whenever digging around your home. Alberta One-Call will send someone to your house to determine the location of all underground services (e.g., electrical, natural gas). Call Alberta One-Call before you dig at 1-800-242-3447 or visit albertaonecall.com.

Check it out!

Visit **http://science5.greenlearning.ca** for 25 interactive online activities covering many electricity topics, such as:

- electricity basics and safety
- electrical currents and circuits
- electromagnetism

You can also find teacher support materials such as section quizzes, unit quizzes and unit planning tools.

LESSON PLAN

Electrons in Motion

Electricity is a part of our daily lives. We would not want to live without electricity, but many of us do not really understand how it works and how dangerous it can be. Every year in North America, people are seriously injured or killed because of incidents involving electricity. Almost all of these incidents are 100 per cent preventable. By understanding more about electricity we can learn to respect it when using, working or playing around it.

General/Specific Learner Outcomes for Grade 5 Science	Time
5-5 Demonstrate safe methods for the study of magnetism and electricity, identify methods for measurement and control, and apply techniques for evaluating magnetic and electrical properties of materials. **1.** 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. • Understand that small batteries are a relatively safe source of electricity, for experimentation and study, but that care should be taken to avoid short circuits. • Understand that short circuits may cause wires to heat up, as well as waste the limited amount of energy in batteries. **4.** Demonstrate that a continuous loop of conducting material is needed for an uninterrupted flow of current in a circuit. **5.** Distinguish electrical conductors – materials that allow electricity to flow through them – from insulators – materials that do not allow electricity to flow through them. **6.** Recognize and demonstrate that some materials, including resistors, are partial conductors of electricity. **7.** Predict the effect of placing an electrical resistance in a simple circuit e.g., in a circuit with a light bulb or electric motor. **10.** Draw and interpret, with guidance, circuit diagrams that include symbols for switches, power sources, resistors, lights and motors. **5-6** Construct simple circuits, and apply an understanding of circuits to the construction and control of motorized devices. **2.** Design and construct circuits that operate lights and other electrical devices. **3.** Recognize the importance of switches and other control mechanisms to the design and operation of electrical devices, and identify purposes of switches in particular applications. **4.** Construct and use a variety of switches.	2.5 hrs

Materials

- **Electrons In Motion** teacher answer key (page 17-18)
- **Electrons In Motion** student worksheet (copy master page 19-20)
- Each group of students should have:
  - 1.5-volt D cell battery with battery holder
  - low voltage light bulb with holder
  - string
  - copper wire or metallic object (e.g., metal cookie cutter)
  - rubber (e.g., old bike tube)
  - one-way switch using a paperclip, two brass fasteners and a small piece of cardboard
  - three insulated wires with alligator clips
  - dry wood (e.g., pencil)
  - glass jar with a thin rim
- For teacher demonstration (see step 6 for instructions):
  - 1.5-volt D battery with battery holder
  - one insulated wire with alligator clips
  - two insulated wires with alligator clips (missing parts of their insulation to show bare wire)
  - low voltage light bulb in holder

Background information	• **#1 The Flow of Electricity** (page 3) • **#2 Safety Devices in Home Electric Systems** (page 5)

Procedure

1. Encourage students to share what they already know about electrical circuits. For example:
   - How does a switch work?
   - What is a circuit?

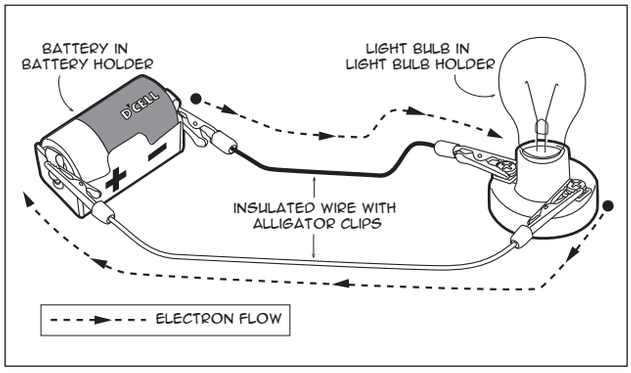
Virtual Lab – Electrical Circuits

Don't have the materials to do this lesson? Don't worry! Visit **http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab** for a virtual electrical circuits lab. It's great for both teacher and student-led lessons!

2. You may choose to introduce the electrical symbols and provide a brief overview of the components of an electric circuit. Divide the class into groups and distribute the Electrons in Motion student worksheet and a set of materials to each group. Instruct the students to write their observations as they do the experiment. In question 3 of the student worksheet, the students will need to mark a check in the "yes" column if the object allowed the bulb to light or put a mark in the "no" column if the light bulb did not light.

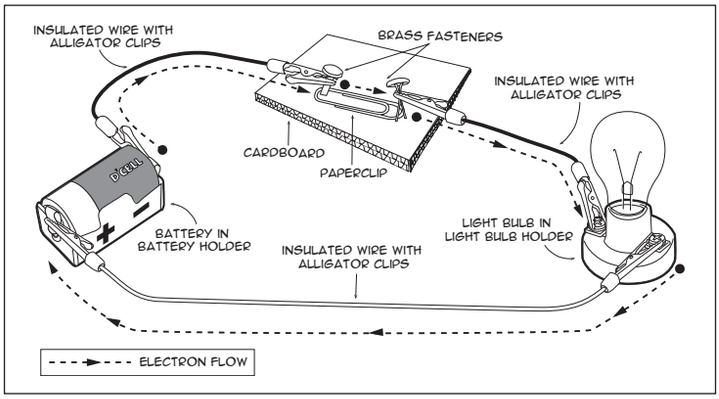
Creating a Circuit

3. a) Ask the students to figure out a way to get the bulb to light, using only two wires, the light bulb and the battery with holder. See diagram, right.
   b) Once students have the light bulb working, ask them to draw their own conclusions based on electrical circuits. You may choose to explain that the circuit is only complete when the light is connected between the two battery terminals.



Switches

4. a) Explain the idea that a switch is used to stop or start electric current. Switches break or complete the circuit. Using the picture below as a guide, ask the students to use the paperclip, two brass fasteners and a 5 cm by 5 cm piece of cardboard to create a switch. This will also mean adding another wire to the circuit.



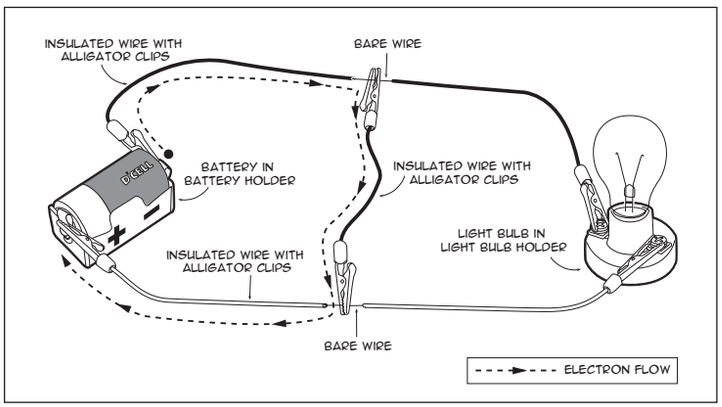
b) Ask students to draw this on their worksheet using the electrical symbols given.

Short Circuits

5. a) Due to safety issues, this portion of the activity should be a teacher demonstration. You will be illustrating a short circuit using two wires that are stripped of about an inch of insulation at the middle of each wire. Using the following diagram, explain that the light bulb should not light up. This is because the electricity is taking the shorter path with the least electrical resistance; therefore, the electric circuit does not include the light bulb.

Demonstration Safety Hazard: Shock Hazard

Do not touch either end of the bare wires, as this may result in an electric shock. Only touch the plastic pieces of the alligator clips when setting up or dismantling this demonstration.



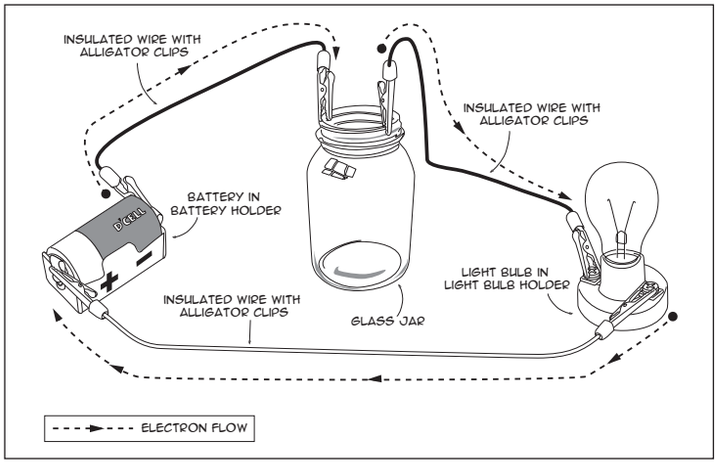
b) Explain to students that the battery will be ‘shorted’ and will heat up because of the high current flow. The current flow is high because there are no parts of the circuit to resist the electricity (e.g., light bulb).

c) Explain that the light bulb is a resistor because it still conducts electricity, but slows the electrons down enough to produce heat and light in the light bulb.

Insulators and Conductors

6. a) To introduce the concept of insulators and conductors, ask students to connect these other materials to the simple electric circuit:
   - dry wood (e.g., pencil)
   - string
   - glass jar with a thin rim
   - copper wire or metallic object (e.g., metal cookie cutter)
   - rubber (e.g., old bike tube)

   Tell students that the objects should be connected between the negative post of the battery and the light bulb. See diagram below.



   b) Instruct students to write their observations as they do the experiment. In question 3 of the student worksheet, students will need to mark a check in the "yes" column if the object allowed the bulb to light or put a mark in the "no" column if the light bulb did not light.

7. Explain that the objects that lit the light bulb are good conductors of electricity because they allowed the electrons to move through them and complete the circuit. The objects that did not light the bulb are insulators and did not allow the electrons to move through them; therefore, the circuit was incomplete. Some materials are better conductors or insulators than others.

8. Ask the following questions to stimulate a concluding class discussion:
   - Since the wires are insulated, what material do you think is inside the plastic?
     – The material is copper and the wires are insulated with plastic because plastic does not conduct electricity.
   - If the wires were not insulated, could you touch them when they are connected to the battery?
     – No, you would feel an electric shock because you would become a part of the electric circuit. The same type of insulation is used to cover home electric wiring.

Extension Activities

- Take a simple flashlight apart to see how it works. Ask students to identify the parts of the circuit.
- Put a couple of groups together to increase the number of materials. Ask students to try adding more materials to the circuits like batteries or light bulbs.

activity 1

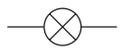
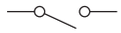
Electrons in Motion

Teacher Answer Key

Have you ever thought about how the electricity in our homes and schools actually works? How about a flashlight? Or why the lights go on when we flip a switch?

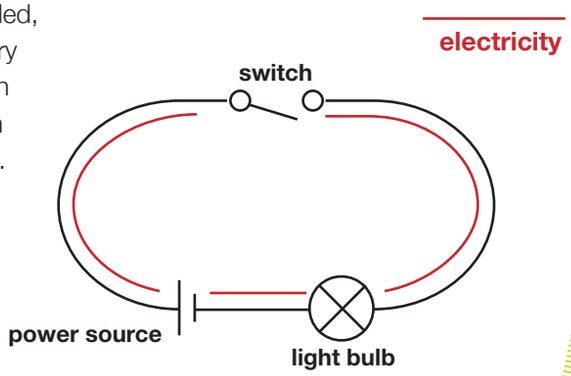
Electricity travels in a circuit. There are a few main parts to a circuit: the light bulb, resistor, switch, power source and motor. In the following activity, you will use these parts to create your own electric circuit.

Electrical Symbols

light bulb	
resistor	
switch	
power source	
motor	

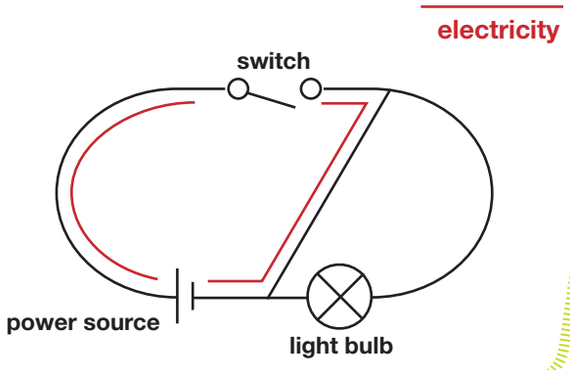
QUESTION 1

Using the electrical symbols provided, draw a simple circuit using a battery (power source), two wires, a switch and a light bulb. Label the parts. In red, highlight the path of electricity.



QUESTION 2

Using the electrical symbols provided, draw the same simple circuit from question 1, but add an extra wire to create a 'short circuit'. Label the parts. In red, highlight the path of electricity.



Electrons in Motion

Electricity travels through some materials better than others. Conductors are materials that allow electricity to travel through them. Insulators resist electricity. You will investigate these two types of materials in the upcoming questions.

QUESTION 3

Which of the following items will light the bulb?

	Yes	No
Glass		✓
Dry wood		✓
String		✓
Copper wire/metal	✓	
Rubber		✓

QUESTION 4

Categorize the items in question 3 as either conductors or insulators.

Conductor	Insulator
Copper wire/metal	Glass
	Dry wood
	String
	Rubber

QUESTION 5

Using your knowledge of conductors and insulators, categorize the following items under the appropriate heading below:

People
Water
Rubber tires
Ground
Metal fences
Wet string
Aluminum ladder
Wooden fence post
Light bulb
Porcelain
Tree

Conductor	Insulator
People	Porcelain
Ground	Rubber
Aluminum ladder	Wooden fence post
Water	
Metal fences	
Tree	
Wet string	
Light bulb*	

**The light bulb is a partial resistor. This means it still conducts electricity, but resists it enough to create some form of energy (e.g., heat and light). It is not an insulator because insulators do not allow any current to flow through; therefore, it would be classified as a conductor.*

activity 1

Electrons in Motion

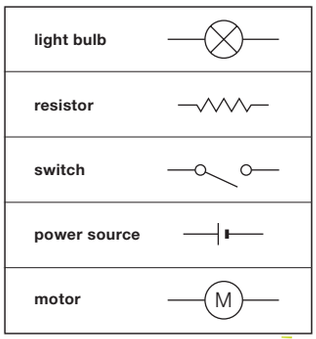
Name _____ **Date** _____

Teacher _____

Have you ever thought about how the electricity in our homes and schools actually works? How about a flashlight? Or why the lights go on when we flip a switch?

Electricity travels in a circuit. There are a few main parts to a circuit: the light bulb, resistor, switch, power source and motor. In the following activity, you will use these parts to create your own electric circuit.

Electrical Symbols



QUESTION 1

Using the electrical symbols provided, draw a simple circuit using a battery (power source), two wires, a switch and a light bulb. Label the parts. In red, highlight the path of electricity.

QUESTION 2

Using the electrical symbols provided, draw the same simple circuit from question 1, but add an extra wire to create a 'short circuit'. Label the parts. In red, highlight the path of electricity.

Electrons in Motion

Electricity travels through some materials better than others. Conductors are materials that allow electricity to travel through them. Insulators resist electricity. You will investigate these two types of materials in the upcoming questions.

QUESTION 3

Which of the following items will light the bulb?

	Yes	No
Glass		
Dry wood		
String		
Copper wire/metal		
Rubber		

QUESTION 4

Categorize the items in question 3 as either conductors or insulators.

Conductor	Insulator

QUESTION 5

Using your knowledge of conductors and insulators, categorize the following items under the appropriate heading below:

People	Ground	Aluminum ladder	Porcelain
Water	Metal fences	Wooden fence post	Tree
Rubber tires	Wet string	Light bulb	

Conductor	Insulator

**The light bulb is a partial resistor. This means it still conducts electricity, but resists it enough to create some form of energy (e.g., heat and light). It is not an insulator because insulators do not allow any current to flow through; therefore, it would be classified as a conductor.*

LESSON PLAN

Electrical Hazards

It is important to identify potential outdoor electricity hazards so students are always alert while playing and/or doing outdoor chores with a parent or guardian.

General/Specific Learner Outcomes for Grade 5 Science	Time
5-5 Demonstrate safe methods for the study of magnetism and electricity, identify methods for measurement and control, and apply techniques for evaluating magnetic and electrical properties of materials. **1.** 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. • Understand that small batteries are a relatively safe source of electricity, for experimentation and study, but that care should be taken to avoid short circuits. • Understand that short circuits may cause wires to heat up, as well as waste the limited amount of energy in batteries.	Part A 30 minutes Part B 45 minutes

Materials – Part A

- **Electrical Hazards – Part A** teacher answer key (page 23)
- **Electrical Hazards – Part A** student worksheet (copy master page 24-26)

Background information	• **#4.1 Electricity Safety Outdoors** (page 8) • **#5.2 Lightning Safety** (page 10)

Procedure – Part A

1. Ask students to suggest what they think the dangers of electricity are and why they are dangerous. Prompt students with the following examples:
   - transformer boxes
   - power lines
   - mixing water and electricity
   - digging in your backyard without underground utility locations marked
2. Using the background information, discuss the concept of path to ground.
3. In pairs or groups, have the students complete the **Electrical Hazards – Part A** student worksheet. You could also allow the pairs or group members to take turns selecting and completing one of the hazards until all are completed.

4. For each picture, have the students identify the potential electric hazard. Use the teacher answer key to review each of the pictures and questions. Ask the students if they have seen some of these hazards in their yards before. If they have, discuss what precautions should have been taken to avoid the electrical hazards.

Physical Education Exercise

Using the background information, discuss the concept of step potential. Assign the students into small teams of 3 or 4. In a large open space, have each team stand single file behind a line. Draw a line exactly 10 metres away. Each student should practice jumping from a platform and landing on two feet. One by one, each student must get to the other line using the "shuffle or hop, don't step" rule.

*Remember: when shuffling, the heel of one foot cannot go past the toes of the other. When hopping, both feet must always be together when they jump and land.

Extension Activities

- Have students create a safety poster demonstrating one safety tip.
- Have students get into groups and create a commercial or song for younger grades demonstrating one safety tip.
- Have students create an "Electricity Safety Action" guide using the tips presented in the worksheet.

activity 2

Part A – Electrical Hazards

Teacher Answer Key – Part A

Make a list of the outdoor electrical hazards found in the pictures.

Picture a. Climbing trees near power lines

Picture b. Using tall farm equipment around overhead lines

Picture c. Underground power lines

Picture d. Playing too close or trying to enter a substation

Picture e. Flying kites too close to power lines

Picture f. Remaining outdoors in a lightning storm

Picture g. Power line on car after accident

Picture h. Power tools close to water

Picture i. Playing on transformer

Picture j. Overhead power lines

1. In Picture d., how can the person safely get his ball back?
   NEVER go inside a substation fence! Phone ATCO and ask for someone to come out and remove the ball.

2. In Picture c., what should the people do first to remain safe?
   They should click before they dig. Visit albertaonecall.com or call 1-800-242-3447.

3. In Picture f., where should the people go to be safe during the lightning storm?
   They should stay indoors during the storm.

4. In Picture g., what should the people in the car do to stay safe?
   The people should stay in the car. However, if there is a fire, they need to hop from the vehicle on both feet, making sure to never touch both the ground and any parts of the vehicle. Then, the people must shuffle or hop (don't step) at least 10 metres away from the vehicle.

5. In Picture g., what should the bystanders do?
   Stay away from the vehicle, until emergency personnel or ATCO arrives to safely remove the downed power line or turn off the power, so there is no electric current running through the wire.

activity 2

Part A – Electrical Hazards

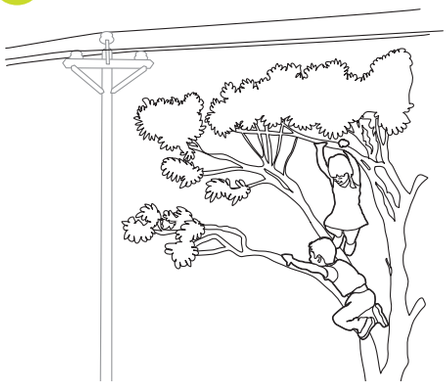
Name _____ **Date** _____

Teacher _____

Electricity always wants to find a path to ground. If you become that path, you can be seriously injured. For each picture, write what the hazard is and colour the electrical flow in red.

REMEMBER: WE SHOULD RESPECT ELECTRICITY.

A



_____

_____

B

_____

_____

C

_____

_____

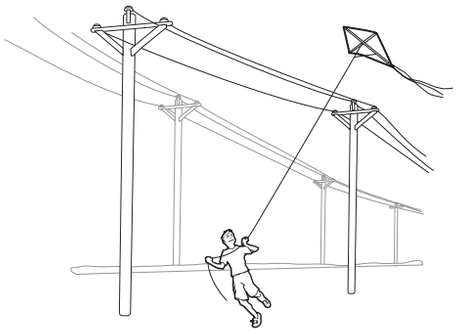
D

_____

_____

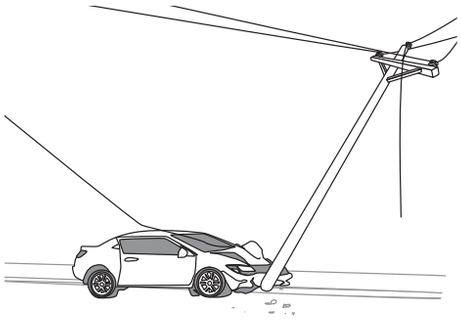
Part A – Electrical Hazards

E

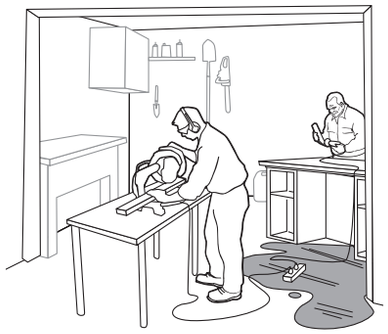


F

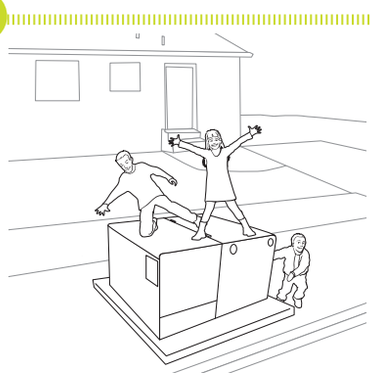
G



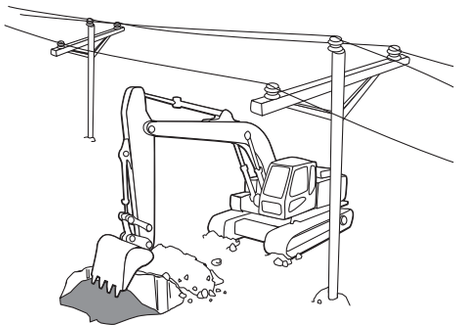
H



I



J



Part A – Electrical Hazards

1. In Picture d., how can the person safely get his ball back?

_____

_____

2. In Picture c., what should the people do first to remain safe?

_____

_____

3. In Picture f., where should the people go to be safe during the lightning storm?

_____

_____

4. In Picture g., what should the people in the car do to stay safe?

_____

_____

5. In Picture g., what should the bystanders do?

_____

_____

LESSON PLAN

Electrical Hazards

Materials – Part B

- **Electrical Hazards – Part B** teacher answer key (page 28-29)
- **Electrical Hazards – Part B** student worksheet (copy master page 30-31)

Background information • **#4.2 Electric Safety at Home and in the Classroom** (page 9)

Procedure – Part B

1. As a class, brainstorm some electrical hazards that can be found in their homes or at school and why it is important to consider safety.
2. Hand out the **Electrical Hazards – Part B** student worksheet. Discuss home safety tips using the background information.
3. Have the students identify potential home hazards from the pictures on their worksheet, colour the area where the hazard is found and list the hazards on the worksheet. Review using the teacher answer key.
4. As a final discussion, compare the types of hazards that can be encountered outdoors to those that might be found indoors.

Extension Activities

- Have the students look for electric hazards in their classroom and/or school. Have them write a report and prepare a presentation. Invite the principal and/or custodian into the class for the presentation to ensure the hazards are removed or repaired.

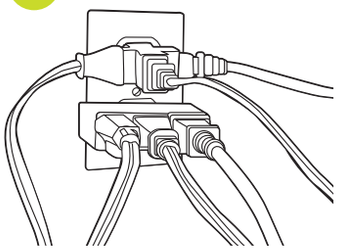
activity 2

Part B – Electrical Hazards

Teacher Answer Key – Part B

Write down the corresponding indoor electrical hazards using the pictures on this page. Colour in the hazardous area and write a general safety tip for each hazard.

1



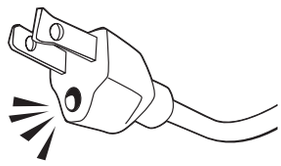
Hazard: Too many electrical devices plugged into one outlet.

General safety tip: Do not plug more electrical devices into an outlet than it is equipped to handle.

2

Hazard: Electric cord missing the ground prong (third prong).

General safety tip: Replace any electric cords that are worn, frayed or have had the ground (third) prong removed.



3

Hazard: Using electric equipment close to water. Bathroom or outside outlets should have a Ground Fault Circuit Interrupter (GFCI).

General safety tip: Remember electricity and water don't mix – never use electric appliances in the tub, sink or shower and never place an electric appliance where it could fall into puddle of water. Outlets in bathrooms and outdoors should have Ground Fault Circuit Interrupters (GFCIs).

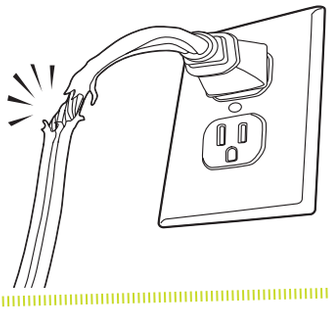
4

Hazard: Putting a knife in an appliance while still plugged in.

General safety tip: Do not repair or clean appliances while they are plugged in.

Part B – Electrical Hazards

5



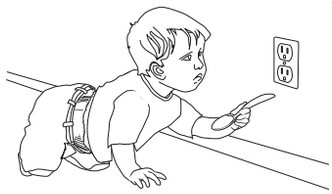
Hazard: Electric cord is frayed.

General safety tip: Replace any electric cords that are worn, frayed or have had the ground (third) prong removed.

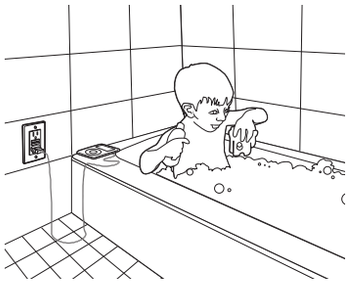
6

Hazard: Putting a spoon into electric outlets.

General safety tip: Do not put things into electric outlets.



7



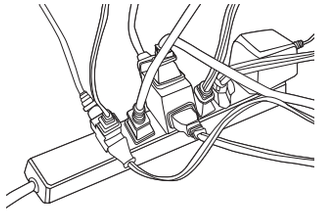
Hazard: Working with electric appliances around water.

General safety tip: Remember electricity and water don't mix – never place an electric appliance where it could fall into a puddle of water, sink or tub.

8

Hazard: Too many electrical devices plugged into one power bar.

General safety tip: Do not plug more electric devices into an outlet than it is equipped to handle.



activity 2

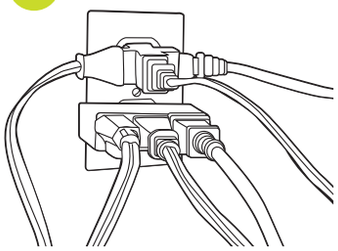
Part B – Electrical Hazards

Name _____ **Date** _____

Teacher _____

Write down the corresponding indoor electrical hazards using the pictures on this page. Colour in the hazardous area and write a general safety tip for each hazard.

1



Hazard: _____

_____

General safety tip: _____

_____

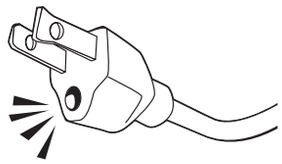
2

Hazard: _____

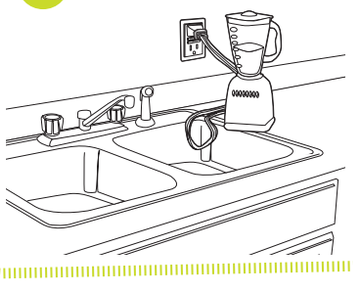
_____

General safety tip: _____

_____



3



Hazard: _____

_____

General safety tip: _____

_____

4

Hazard: _____

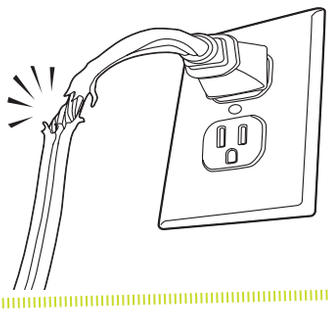
_____

General safety tip: _____

_____

Part B – Electrical Hazards

5



Hazard: _____

_____

General safety tip: _____

_____

6

Hazard: _____

_____

General safety tip: _____

_____

7

Hazard: _____

_____

General safety tip: _____

_____

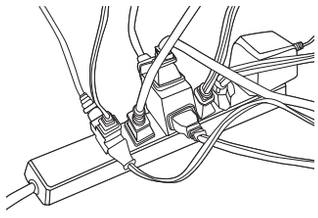
8

Hazard: _____

_____

General safety tip: _____

_____



Activity Three

LESSON PLAN

Home Safety Inspection

Most electrical accidents occur in the home. It is important for students to be able to identify potential electrical hazards in the home.

General/Specific Learner Outcomes for Grade 5 Science	Time
5-5 Demonstrate safe methods for the study of magnetism and electricity, identify methods for measurement and control, and apply techniques for evaluating magnetic and electrical properties of materials. **1.** 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. • Understand that small batteries are a relatively safe source of electricity for experimentation and study, but that care should be taken to avoid short circuits. • Understand that short circuits may cause wires to heat up, as well as waste the limited amount of energy in batteries.	30 minutes

Materials

- **Letter to Parents** teacher copy (page 34)
- **Emergency Phone List** teacher answer key (page 35)
- **Emergency Phone List** student worksheet (copy master page 38)
- **Home Safety Inspection** teacher answer key (page 36-37)
- **Home Safety Inspection** student worksheet (copy master page 39-40)
- **Home Safety Inspection** certificate for students
- Sheet of paper for posting.

Background information • **#4.2 Electric Safety At Home and in the Classroom** (page 9)

Procedure

1. Ask the students to brainstorm what they think an electrical safety inspector does.
2. Inform the students that they will now be electrical safety inspectors. They will be inspecting their own homes, identifying any potential electrical hazards, and will also be reminded about how to respond to emergencies.
3. Hand out the signed **Letter to Parents**, **Home Safety Inspection** and **Emergency Phone List** to each student. Give the students time to read the letter. Have each student address and sign his or her letter.

4. Review the student worksheet to prepare them for their home activity.
5. Using the background information as a guide, brainstorm a list of home and outdoor electrical hazards with the students.
6. Assign the students two or three days to complete the home activity and let them know that they are to return the worksheet with a parent or guardian's signature.
7. When all the students have completed the home portion of the **Home Safety Inspection**, compile the class results into a graph or chart by totalling the number of potential electrical hazards and the number of hazards to be reduced. This may be assigned as individual work or could be completed as a class.
8. You may download the **Home Safety Inspection Certificate** for each student when they have handed in their **Home Safety Inspection** worksheet.
9. As a conclusion, ask the students to reflect on what they have learned about electrical safety and to provide electrical safety tips they will apply to their daily lives.

Extension Activities

- Have the students prepare presentations (using PowerPoint, webpage software, poster boards, etc.) on electrical safety and present them to the class.
- Make emergency phone lists for all school phones.
- Have the students create classroom safety rules for building and experimenting with electrical devices in their Science classroom.

Notice to Parents/Guardians

Our class is learning about electrical safety from ATCO's **Teaching Power** program. We are learning how important it is for us to understand and respect electricity. Every year in North America, people are seriously injured or killed because of incidents involving electricity. Almost all of these incidents are 100 per cent preventable.

Our class has already studied how electricity flows and what materials make good insulators and conductors. We have also studied outdoor electric hazards and ways to stay safe around electricity. For example, by calling Alberta One-Call (1-800-242-3447) or clicking albertaonecall.com, you can ensure your safety when digging around your home. Alberta One-Call is a free service that determines the location of all underground services in your yard.

We are now learning about electricity safety in the home. In class, we have made an emergency phone list of local emergency numbers, including the ATCO number. Please help your child post this in the most appropriate location in your home and fill in any important phone numbers.

The students also have a home activity to do which is explained below. When it is finished, we will compile a classroom total of the number of electric hazards found and how many were reduced (they will not be broken down by household.

Thank you for taking the time to help us with this activity. Learning about electricity helps us all to be Power Safe.

Sincerely,

_____

Teacher

Dear _____

I have a project to do in our home. I will be looking for potential electric hazards in and around our home and I will need to meet with you to decide what can be done to reduce or repair the hazards.

Thank you for helping me with this activity and please remember to sign the worksheet when I am finished the **Home Safety Inspection**.

Sincerely,

_____

Student

activity 3

Home Safety Inspection

Teacher Answer Key – Emergency Telephone List

When an emergency happens you do not have time to flip through a phone book looking for phone numbers you need. In this activity, you will make your own Emergency Phone List. When the list is finished, cut it out and be sure to put it close to the phone, where everyone in your family can see it!

EMERGENCY PHONE LIST

Local Emergency Number*	911
ATCO	1-800-668-5506
Police	911 if available and local number
Fire Department	911 if available and local number
Ambulance	911 if available and local number
Doctor	students may need to fill this in at home
Hospital	students may need to fill this in at home
Poison Information Centre	1-800-332-1414
Alberta One Call	1-800-242-3447

** check to see if you have a three-digit emergency number in your area (911)*

activity 3

Home Safety Inspection

Teacher Answer Key – Home Safety Inspection

It's time to see how safe your home is. In this activity, you will be doing a safety inspection of your home. You will also be discussing electrical safety with your family.

QUESTION 1

Use this list of different types of home and outdoor electric hazards. Beside each hazard, check off beside each hazard the number of times you locate it in or around your home or if you have observed this hazard in the past. Add the check marks to reach the total. Add the two totals together to get a grand total.

Indoor Hazards	Number of Times Found	Location	Fixed or Will be Fixed
Using frayed electric cords or ungrounded cords	2	Bathroom, Bedroom	✓ ✓
Too many cords in one outlet	1	Kitchen	✓
Appliances close to water	1	Bathroom	✓
Overloaded power bar			
Outlets without Ground Fault Circuit Interrupters (GFCIs)	1	Bathroom	✓
Electrical cord hidden underneath rug	1	Living Room	✓
Putting objects into electric outlets			
Repairing or cleaning appliances while plugged in	1	Kitchen	✓
Total Number of Indoor Hazards	**7**	**Total Number of Hazards to be Fixed**	**7**

Outdoor Hazards	Number of Times Found	Location	Fixed or Will be Fixed
Water around power tools	1	Garage	✓
Trees touching power lines	1	House	✓
Using tall equipment near overhead lines (e.g., grain augers, ladder)	1	Auger	✓
Using frayed electric cords or ungrounded cords	1	Garage	✓
Using electric equipment in or near water			
Total Number of Outdoor Hazards	**4**	**Total Number of Hazards to be Fixed**	**4**

Total Number of Outdoor and Indoor Hazards Found = 11

Home Safety Inspection

2. Student answers will vary.

3. Student answers will vary.

4. Arrange a date for students to hand back the completed home safety inspections with a signature from their parents.

activity 3

Home Safety Inspection

Name _____ **Date** _____

Teacher _____

When an emergency happens you do not have time to flip through a phone book looking for phone numbers you need. In this activity, you will make your own Emergency Phone List. When the list is finished, cut it out and be sure to put it close to the phone, where everyone in your family can see it!

EMERGENCY PHONE LIST

Local Emergency Number*	
ATCO	1-800-668-5506
Police	
Fire Department	
Ambulance	
Doctor	
Hospital	
Poison Information Centre	
Alberta One Call	

** check to see if you have a three-digit emergency number in your area (911)*

activity 3

Home Safety Inspection

Name _____ **Date** _____

Teacher _____

It's time to see how safe your home is. In this activity, you will be doing a safety inspection of your home. You will also be discussing electric safety with your family.

QUESTION 1

Use this list of different types of home and outdoor electric hazards. Beside each hazard, check off beside each hazard the number of times you locate it in or around your home or if you have observed this hazard in the past. Add the check marks to reach the total. Add the two totals together to get a grand total.

Indoor Hazards	Number of Times Found	Location	Fixed or Will be Fixed
Using frayed electric cords or ungrounded cords			
Too many cords in one outlet			
Appliances close to water			
Overloaded power bar			
Outlets without Ground Fault Circuit Interrupters (GFCIs)			
Electrical cord hidden underneath rug			
Putting objects into electric outlets			
Repairing or cleaning appliances while plugged in			
Total Number of Indoor Hazards		**Total Number of Hazards to be Fixed**	

Outdoor Hazards	Number of Times Found	Location	Fixed or Will be Fixed
Water around power tools			
Trees touching power lines			
Using tall equipment near overhead lines (e.g., grain augers, ladder)			
Using frayed electric cords or ungrounded cords			
Using electric equipment in or near water			
Total Number of Outdoor Hazards		**Total Number of Hazards to be Fixed**	

Total Number of Outdoor and Indoor Hazards Found = _____

Home Safety Inspection

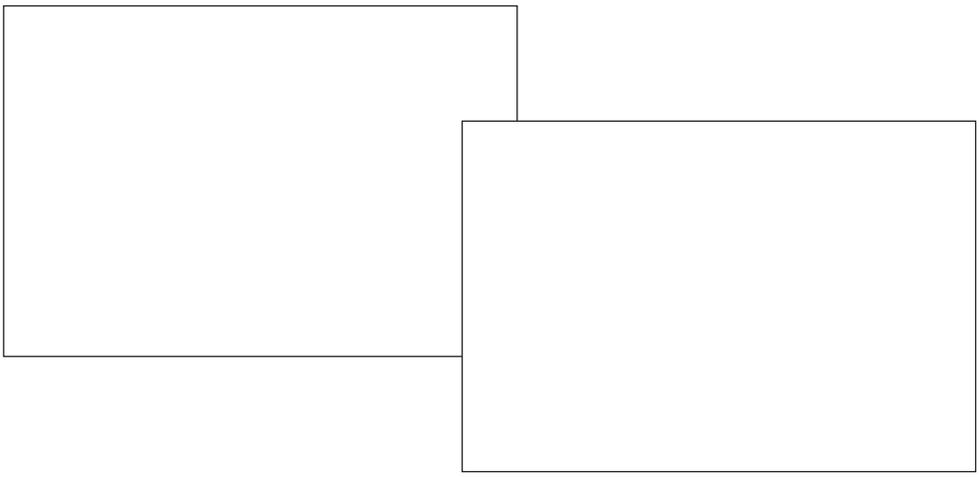
QUESTION 2

a) Pick one of the hazards and recall why it is dangerous.

_____

_____

b) Draw what the hazard looked like and then draw what it should look like.



QUESTION 3

Arrange a time to meet with your family. Show them the hazards you found and talk about what can be done to eliminate or reduce them. Put a checkmark beside the hazards that your family will fix. The work doesn't have to be done immediately, as long as your family agrees that they will do something about it.

QUESTION 4

Write the total number of hazards that you have in your home and then the number that will be fixed below.

My total number of indoor and outdoor hazards was _____.

My total number of indoor and outdoor hazards that will be fixed is _____.

_____

Parent or Guardian Signature

This home inspection is to be handed in by _____, _____.

Glossary

Amperage – measures electric current - the number of electrons flowing though an electric wire. Amperage can be compared to the size of the spray that comes out of a hose with a nozzle on the end. A large spray compares to high amperage.

- **Amp** – unit used to measure amperage
- **Milliamps** – small units measuring the flow of electricity (1 amp = 1,000 milliamps)

Circuit Breaker – switch or relay that breaks (opens) an electric circuit and stops the electric current. Circuit breakers are found in distribution panels.

Conductors – material through which electricity travels easily. Electricity conducts well through metals and water.

Distribution Panel – a box (typically gray) in the basement of most houses that distributes the electricity throughout the house. Electricity travels from the generating station to the distribution panel to lights, outlets and electric appliances.

Distribution Line – power lines carrying electricity from substations to power pole (or underground) transformers. Distribution lines are often supported by wooden power poles and use lower voltage than transmission lines. Some distribution lines are buried underground.

Electric Circuit – the path electrons take through an electric device. A flashlight is an example of a simple electric circuit as the electrons flow from the negative post (-) on the battery to the light bulb to the positive post (+) through wires.

Electric Grid – network of power lines that transports electricity from generating stations to homes, businesses and industries.

Electrically Neutral – matter that does not have either a positive or negative electrical charge.

Electrons – negatively charged particles that orbit around the center of the atom. The center of the atom contains neutrons and protons.

Ground Wire – a green or bare wire in household wiring that is designed for safety. A ground wire is one of three wires in all household wiring. The ground wire's purpose is to direct any short circuits into the ground instead of through a person.

Ground Fault Circuit Interrupter (GFCI) – An outlet or circuit breaker designed to detect leaking ground current. If a ground current leak is sensed the circuit opens and stops the electric current. Outlets with a GFCI have a test and reset button to test the GFCI. Plug in an appliance and press test. The appliance should not turn on. Remember to press the reset button to reactivate the GFCI. GFCI's are mostly found in rooms where there is water (e.g., bathroom, kitchen, etc.).

Grounded Circuit – a circuit that contains a path for electrons to flow to the ground in the event of a short circuit.

Insulators – material through which electricity does not travel well. Glass, rubber and plastic are good insulators.

Lightning – the release of static electricity typically occurring during a thunderstorm.

Negatively Charged – atoms that have gained electrons, therefore the number of electrons will be higher than the number of protons.

Neutrons – neutrally-charged particles that are found within the center of the atom. Protons are found here as well.

Path to Ground – route electricity takes to get to the ground. Electricity is constantly searching for the shortest route available.

Positively Charged – atoms that have lost electrons, therefore the number of electrons will be lower than the number of protons.

Protons – positively-charged particles that are found within the center of the atom. Neutrons are found here as well.

Resistor – an electrical device that slows down the flow of electrons in a circuit due to friction. An example of this would be a light bulb. The coil in a light bulb resists the flow of electrons and slows it down. As the electrons are slowing down, the friction creates light and heat.

Service Line – low voltage power lines that carry electricity from the power pole or pad transformers to customers. Service lines carry two 120-volt lines of electricity into houses.

Short Circuit – any unintended path in an electric circuit providing electricity either a path to ground or path between live conductors. For example, if a hot wire in an electric lawn mower becomes loose and touches some metal part of the mower, the electricity will run through the lawn mower into the ground. This is a short circuit.

Step Potential – difference in voltage between the foot closest to the source of electricity and the foot farther away.

Substation – fenced facility operated by ATCO that houses high voltage transformers and circuit breakers. Transformers change electricity from one voltage to another.

Transformer – changes the voltage of electricity. Electricity is transformed to a very high voltage before it is transported through transmission lines. However, homes and businesses require low voltage electricity; therefore transformers can also convert the electricity to lower voltages. Transformers are found in substations, on power poles and in (typically green or gray) metal boxes on the ground in urban neighbourhoods. Transformers on the ground are typically connected to buried power lines.

Transmission Lines – Transmission lines carry high voltage electricity. They are often supported by high, steel or concrete transmission towers or wooden poles.

Voltage – the “pressure” of electricity in a circuit, like the water pressure in a garden hose.

- Volt – unit used to measure voltage, or the “pressure” of electricity in an electric circuit. Household appliances either require 120 or 240 volts of electricity.

MCOM 05/2020