Activity Preparation for Chapter 6

Activity/Investigation	Advance Preparation	Time Required	Other Considerations
What's Going On? The Short Story (page 107) (TR page 133)	• 1 day before – Cut aluminum foil strips and check that the batteries are working.	• 30 min	• Caution students to hold the foil in place on the battery for only five seconds.
What's Going On? Develop Your Own Checklist (page 112) (TR page 136)	• Day of – Bring in several common electric devices. – Photocopy any assessment masters you decide to use.	• 30 min	• Some students could benefit from completing this activity with a partner.
Find Out: Measuring Current in a Circuit (page 115) (TR page 142)	• 2 days before – Photocopy any or all of **BLM 6–4 Ammeter Scale**, **BLM 6–5 Reading an Ammeter Scale**, and **BLM 6–6 Multimeter Scales**, as well as any assessment masters you decide to use. • 1 day before – Check batteries, bulbs, and ammeters to make sure they are in working order.	• 40 min	• If students will be using an analogue meter, consider using any or all of **BLM 6–4 Ammeter Scale**, **BLM 6–5 Reading an Ammeter Scale**, and **BLM 6–6 Multimeter Scales** as overhead projections or have students complete them at their desks before beginning this activity.
Find Out: Measuring Voltage in a Circuit (page 117) (TR page 143)	• 2 days before – Photocopy either or both of **BLM 6–6 Multimeter Scales** and **BLM 6–8 Reading a Voltmeter Scale**, as well as any assessment masters you decide to use. • 1 day before – Check batteries, bulbs, and ammeters to make sure they are in working order.	• 40 min	• If students will be using an analogue meter, consider using either or both of **BLM 6–6 Multimeter Scales** and **BLM 6–8 Reading a Voltmeter Scale** as overhead projections or have students complete them at their desks before beginning this activity.

Materials Needed for Chapter 6

Activity/Investigation	Apparatus	Materials	Blackline Masters
What's Going On? The Short Story (page 107) (TR page 133)	For each group: • 9 V D-cell battery	For each group: • strip of aluminum foil (1 cm × 10 cm)	
What's Going On? Develop Your Own Checklist (page 112) (TR page 136)	• several common electric devices, such as a flashlight, hair dryer, and portable disk player		**Optional** Assessment Checklist 1 Co-operative Group Work Checklist Assessment Checklist 2 Co-operative Group Work Rubric Assessment Checklist 8 Scientific Communication Rubric
Find Out: Measuring Current in a Circuit (page 115) (TR page 142)	For each group: • 6 V battery in holder • 6 V light bulb in holder • switch • 4 wires with alligator clips • ammeter or multimeter		**Optional** BLM 6–4 Ammeter Scale BLM 6–5 Reading an Ammeter Scale BLM 6–6 Multimeter Scales Assessment Master 11 Using Tools and Equipment Checklist Assessment Master 12 Using Tools and Equipment Rubric
Find Out: Measuring Voltage in a Circuit (page 117) (TR page 143)	For each group: • 6 V battery in holder • 6 V bulb in holder • switch • 5 wires with alligator clips • voltmeter or multimeter		**Optional** BLM 6–6 Multimeter Scales BLM 6–8 Reading a Voltmeter Scale Assessment Master 11 Using Tools and Equipment Checklist Assessment Master 12 Using Tools and Equipment Rubric

CHAPTER 6 Working with Circuits (page 106)

SUGGESTED TIMING

15 min

BLACKLINE MASTERS

BLM 5–3 Circuit Diagrams
BLM 6–1 Stay Safe Around Electric Wiring

Overall Expectations

PECV.01 – describe the characteristics of electrical circuits
PECV.02 – investigate simple electrical circuits, using safe practices
PECV.03 – analyze the practical uses of electrical circuits and their impact on daily life
SILV.01 – illustrate how science is a part of daily life
SILV.02 – use appropriate scientific skills, tools, and safety procedures to investigate problems
SILV.03 – examine the connections between science and activities in daily life
BSAV.03 – analyze how personal health and safety in everyday life and in the workplace are protected through the proper use of equipment and safety practices

Key Terms Teaching Strategies

Students learned the terms "conductor," "source," "load," and "switch" in Chapter 5. Because these key terms are used extensively in Chapter 6, review the meaning of each term now. You could use **BLM 5–3 Circuit Diagrams** as an overhead transparency to review these terms.

Activity Planning Notes

Lead a discussion about the illustration on page 106 of the student resource. Students may have observed a battery being charged, and may even have some idea about the fact that jumper cables must be set up in a particular way. Discuss how cables connected incorrectly will create a short circuit and be an electric hazard.

Review the safety precautions given on page 101 of the student resource. You may wish to use **BLM 6–1 Stay Safe Around Electric Wiring** as an overhead master to help students review precautions.

Consider using the following blackline masters:
- **BLM 5–3 Circuit Diagrams**
- **BLM 6–1 Stay Safe Around Electric Wiring**

Making Connections Answers (page 106)

1. load
2. source
3. conductor

6.1 Circuit Safety (page 107)

SUGGESTED TIMING	MATERIALS	BLACKLINE MASTERS
30 min 30 min for What's Going On?	• 2 wires with alligator clips • 1.5 V light bulb in holder • 1.5 V D-cell battery in holder • additional circuit components (optional)	BLM 6–1 Stay Safe Around Electric Wiring BLM 6–2 Symbols for Circuits OHT B–4 Safe and Unsafe Circuits OHT B–5 Building Circuits Checklist

Specific Expectations

PEC1.01 – use scientific terminology during investigations to describe basic electrical concepts and related units of measure
PEC1.02 – demonstrate an understanding that electrical energy can be converted into other forms of usable energy within electrical circuits
PEC1.04 – use a variety of symbols to represent different components in electrical circuits
PEC2.03 – conduct investigations, using electrical materials, tools, and equipment safely
PEC2.05 – extract and interpret information from instructions and manuals for circuits and electrical devices
PEC2.06 – communicate plans and results of investigations about electrical circuits, using a variety of oral, written, and graphic formats
SIL2.03 – conduct investigations safely, using appropriate lab equipment

Key Terms Teaching Strategies

Add the key terms to the word wall. Discuss the meaning of "hazard" (a danger or risk). Students should have some prior knowledge of the dangers and risks of electricity. Students may also know that if they connect the wires incorrectly, they may cause a short circuit. Explain to students that wires may become hot in a short circuit and cause a fire.

Reading Icon Answer (page 107)

4. Students will likely highlight "can damage" and "creates a risk."

Reading Icon Answer (page 108)

1. Electric energy is converted to heat in the conductor.

Activity Planning Notes

Review the need for safety whenever working in the lab and the precautions for working with circuits. You may wish to use **BLM 6–1 Stay Safe Around Electric Wiring** to review the points from page 101 if you did not use it with the chapter opener.

For Reading Icon question 4 on page 107, you could instruct students to highlight two phrases rather than two verbs that describe why circuits can be a problem if they are not connected properly.

Do the What's Going On? activity on page 107, and then continue with the work on short circuits. You may wish to use **OHT B–4 Safe and Unsafe Circuits** as you discuss with students the danger shown in Circuit B on page 108.

Review circuit diagrams and ensure that students know and use the correct symbols. You may wish to distribute **BLM 6–2 Symbols for Circuits** to remind students of the symbols to use in drawing a circuit diagram. You could also make a large chart of the symbols to place on a bulletin board for students to refer to.

Students could share their answers as they discuss the Making Connections question on page 108.

Use **OHT B–5 Building Circuits Checklist** as you lead a discussion on circuit building for page 109. You should have all the apparatus for circuit building on the desk and follow the safety rules as you build a circuit.

Point out that there are four main rules for building circuits listed on page 109, and that students should learn all four rules.

Consider using the following blackline masters and overhead transparencies during this section:

- **BLM 6–1 Stay Safe Around Electric Wiring**
- **BLM 6–2 Symbols for Circuits**
- **OHT B–4 Safe and Unsafe Circuits**
- **OHT B–5 Building Circuits Checklist**

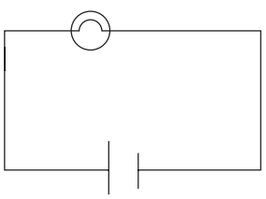
Accommodations

- It will help to reinforce the safety points if you ask students to identify what you are doing *wrong* as you build a circuit. Ask them to also identify why each action is incorrect. You may wish to exaggerate the errors as you demonstrate them. For example, start building your circuit on a pile of papers on a very messy desk. Consider demonstrating every point from the checklist on page 109 by doing something incorrect.

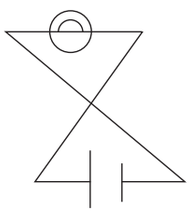
Check Your Understanding Answers (page 108)

2. Circuit A is safe.

3. a)



b)



Making Connections Answer (page 108)

4. The conductors act as the load. All the energy is converted to heat and not sent to the load.

What's Going On? Activity (page 107)

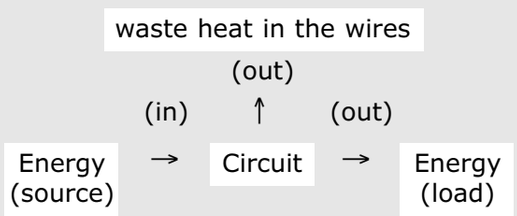
The Short Story

Purpose

- Students learn about electric safety, electric hazards, and the dangers of short circuits.

Science Background

Describe circuits as you draw the following flowchart on the chalkboard.



Point out that a circuit transfers energy from a source to a load in a controlled way. The amount of energy that enters the circuit must balance the amount needed by the load. If there is not enough energy, then the load will not do its job. If there is too much energy, then too much waste heat is produced. Too much waste heat can cause a fire.

Circuits are designed to safely carry a specific amount of current. A short circuit is a circuit that has too much energy going through it and no loads to use up the energy. Another unsafe circuit is one that is overloaded (too many loads are connected), which can cause wires to overheat and start a fire.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
1 day before	• Cut aluminum foil strips and check that the batteries are working.

APPARATUS	MATERIALS
• 9 V D-cell battery	• strip of aluminum foil (1 cm × 10 cm)

Suggested Timing

30 min

Safety Precautions

- Caution the students to hold the foil in place on the battery for only five seconds.
- Remind students to clean up their work area, put away all equipment, and wash their hands after this activity.

Activity Planning Notes

This activity is very simple and students should have very little problem in following the instructions. You can begin by asking students to predict what will happen when they hold the foil in place for five seconds. Ask students to suggest reasons for their predictions.

Students may have problems in determining why the foil heated up. They may not realize that if there is no useful load to convert the electric charge, the charge is converted to heat. Most students will be merely making observations and will come to a conclusion later. Some students may identify the energy conversion that occurs.

Keep an eye on all students making sure that they hold the foil for only five seconds. You may want to use a timer or bell to indicate when five seconds is up.

Accommodations

- Students can work in pairs, with each student holding one end of the foil to the battery, or with one student holding both ends and the other student feeling the foil in the middle of the strip.

What Did You Find Out? Answers (page 107)

3. The circuit is closed because an electric current is flowing through it.

4. The electric energy is changed into heat.

5. This kind of circuit could get so hot that it would start a fire.

Activity Wrap-up

- Students could research the Ontario Electrical Safety Codes and list five safety rules from the information they researched.

Technology Links

For more information on the electrical safety codes for Ontario, go to **www.mcgrawhill.ca/books/Se9** and follow the links to Safety Alerts.

Ongoing Assessment

- Ask students to list the four rules for building circuits (safety comes first; connect loads in order; face all batteries the same way; keep switches off). Encourage them to list the rules as a checklist. Collect answers and assess whether all four are listed.

Accommodations

- Students whose writing skills are not as strong may find it easier to list the four rules orally or to illustrate the rules.

Alternative Activity

- Supply students with **BLM 6–2 Symbols for Circuits**. Have students cut out the symbols and then work in pairs or small groups to demonstrate building a (paper) circuit following the safety rules on page 109. Students who are demonstrating could purposely demonstrate one of the rules incorrectly and the partners can try to catch and correct the action. Students should reverse the roles so everyone gets a chance to demonstrate using the paper symbols.

6.2 Testing Circuits (page 110)

SUGGESTED TIMING

30 min
30 min for What's Going On?

BLACKLINE MASTERS

OHT B–6 Circuits Checklist
Assessment Master 1 Co-operative Group Work Checklist
Assessment Master 2 Co-operative Group Work Rubric
Assessment Master 8 Scientific Communication Rubric

Specific Expectations

PEC1.01 – use scientific terminology during investigations to describe basic electrical concepts and related units of measure
PEC1.02 – demonstrate an understanding that electrical energy can be converted into other forms of usable energy within electrical circuits
PEC1.03 – identify how household and workplace electrical devices operate by converting energy to another form
PEC1.04 – use a variety of symbols to represent different components in electrical circuits
PEC2.05 – extract and interpret information from instructions and manuals for circuits and electrical devices
PEC3.01 – identify circuits and their components in household and workplace settings PEC3.02 – develop a logical checklist to troubleshoot an electrical device of personal choice
PEC3.02 – develop a logical checklist to troubleshoot an electrical device of a personal choice
SIL1.01 – describe how the procedures, skills, and tools employed in different areas of science are also evident in daily life
SIL3.03 – demonstrate an understanding of how problem-solving and decision-making activities in the workplace use scientific process skills

Key Terms Teaching Strategies

Ask students to identify the two words that make up the compound word "checklist." Have students explain the meanings of the two words, and from those meanings, infer the meaning of "checklist." Students will have some prior knowledge of checklists. They can share when and how they have used checklists.

Activity Planning Notes

Read aloud the first paragraph on page 110 of the student resource, and lead a discussion on interpreting the illustration. Ask students why the DVD player is not working. Work together to devise a checklist related to the problem in the illustration. Then together read the description on page 110 and compare that checklist to the class checklist. The class checklist may have included an additional point that the connection to the power source is not showing, and that might be the reason the device is not working.

After completing the introductory part of this lesson, have students do the What's Going On? activity on page 112.

Accommodations

- Some students might not make the connection between a circuit built in the science lab and the real-life circuits found in the home. Explain that the same basic components are in each: source, load, conductor, and switch. Work together to identify each of the circuit components in the scene shown on page 110.

Consider using the following overhead transparency in this section:

- **OHT B–6 Circuits Checklist**

Check Your Understanding Answers (page 110)

1. a) The dryer is not working because the circuit is not complete.

b) Valerie should turn the switch off and then connect the plug properly.

Check It Out Answers (page 111)

2.

Test	✓
Is the circuit complete?	✓
Is the switch closed?	✓
Are all the wires properly connected?	✓

3.

Test	✓
Is the circuit complete?	✗
Is the switch closed?	✓
Are all the wires properly connected?	✓

4.

Test	✓
Is the circuit complete?	✗
Is the switch closed?	✗
Are all the wires properly connected?	✓

5.

Test	✓
Is the circuit complete?	✓
Is the switch closed?	✓
Are all the wires properly connected?	✗

Making Connections Answer (page 111)

6. You might try a different bulb or a different battery. You could also try new wires with alligator clips.

What's Going On? Activity (page 112)

Develop Your Own Checklist

Purpose

- Students develop a checklist for testing an electric device.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
Day of	• Bring in several common electric devices. • Photocopy any assessment masters you decide to use.

APPARATUS	MATERIALS
• several common electric devices, such as a flashlight, hair dryer, and portable disk player	

Suggested Timing

30 min

Activity Planning Notes

Invite students to talk about any prior knowledge and experience they have with trying to figure out why an electric device did not work. For example, they may have a flashlight that worked the last time they used it, but no longer does. Review what the source, load, conductor, and switch in a flashlight consist of, and how students might figure out why the light is not working.

Display several common electric devices to help give students ideas of what to draw.

Accommodations

- You may wish to allow some students to choose an example discussed in class (such as the flashlight) to draw and label.
- Some students could benefit from completing this activity with a partner.

What to Do Answers (page 112)

2. Students may have selected devices such as a television set, VCR, hair dryer, or computer. Cords are the conductors, the on/off button is the switch, the wall outlet/ battery is the source, and the device is the load.

3. Look for ideas such as the following.

Question	How Will I Check?
Is the switch on?	Check to make sure that the switch is in the "on" position.
Is the circuit complete?	Make sure that the circuit has a plug in the outlet (source), a device (load), and wires (conductors).
Are the wires connected properly?	Check to see that cords are properly connected (conductors).
Is the device connected to a source?	Check that the device is plugged into a wall socket.
Is the power on?	Check that there is power in the circuit.

What Did You Discover? Answer (page 112)

4. Answers may vary. Most students will have a variation on the answers to question 3 above.

Activity Wrap-up

- Students could meet with a partner and take turns, with one student asking the questions from the checklist, and the other student providing the answer for "How will I check?"
- Challenge pairs or small groups of students to devise several other questions that could be used on a checklist for an electric device.
- If students have worked together to complete this activity, you may wish to have them complete **Assessment Master 1 Co-operative Group Work Checklist**.

Ongoing Assessment

- You may wish to meet with students individually and have them explain their drawings and choices for their checklists. Use **Assessment Master 8 Scientific Communication Rubric** to help you assess their answers.
- If students worked together to complete this activity, you could use **Assessment Master 2 Co-operative Group Work Rubric**.

Technology Links

- For examples of electric safety checklists, go to **www.mcgrawhill.ca/books/Se9** and follow the links to Checklists.

Alternative Activity

- Download several examples of checklists from electric safety web sites and have students examine the content. The reading level may be fairly high on some web sites, but students could skim through the points listed and highlight key terms that they recognize. They can work with a partner or in a small group to discuss their findings and what each point on the checklist means.

6.3 Current and Voltage (page 113)

SUGGESTED TIMING

30 min
40 min for Find Out: Measuring Current in a Circuit
40 min Find Out: Measuring Voltage in a Circuit

BLACKLINE MASTERS

BLM 6–3 Water Tank
BLM 6–4 Ammeter Scale
BLM 6–5 Reading an Ammeter Scale
BLM 6–6 Multimeter Scales
BLM 6–7 Voltage and Current in a Circuit
BLM 6–8 Reading a Voltmeter Scale
BLM 6–9 Advanced Circuit Master Certification
OHT B–7 Voltmeter
OHT B–8 Electric Safety Checklist
Assessment Master 8 Scientific Communication Rubric
Assessment Master 11 Using Tools and Equipment Checklist
Assessment Master 12 Using Tools and Equipment Rubric
Assessment Master 17 Poster Checklist
Assessment Master 18 Poster Rubric

Specific Expectations

PEC1.01 – use scientific terminology during investigations to describe basic electrical concepts and related units of measure
PEC1.02 – demonstrate an understanding that electrical energy can be converted into other forms of usable energy within electrical circuits
PEC1.03 – identify how household and workplace electrical devices operate by converting energy to another form
PEC1.04 – use a variety of symbols to represent different components in electrical circuits
PEC2.01 – formulate scientific questions about circuits and create a simple plan to carry out an investigation, including safety procedures
PEC2.02 – design, build, and test an electrical circuit to investigate the chosen question, using appropriate safety procedures
PEC2.03 – conduct investigations, using electrical materials, tools, and equipment safely
PEC2.04 – measure and record the current and potential difference in simple circuits through the safe and proper use of an ammeter and a voltmeter
PEC2.05 – extract and interpret information from instructions and manuals for circuits and electrical devices
PEC2.06 – communicate plans and results of investigations about electrical circuits, using a variety of oral, written, and graphic formats
SIL1.01 – describe how the procedures, skills, and tools employed in different areas of science are also evident in daily life
SIL2.05 – assess data to make inferences and conclusions and to answer questions and refine procedures
SIL2.06 – communicate plans, observations, and results using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate
SIL3.03 – demonstrate an understanding of how problem-solving and decision-making activities in the workplace use scientific process skills

Key Terms Teaching Strategies

Introduce and discuss the meaning of "meter" (a device that measures, or measures and records) and ask students to suggest what the meaning of "ammeter," "multimeter," and "voltmeter" might be. Be sure to differentiate this type of meter from a meter (also metre) stick, which is also a measurement device. You may wish to discuss that some words have more than one meaning. Students may wish to contribute other common examples, such as ring, bolt, and purse.

Discuss the students' experiences and prior knowledge of "current" and "voltage." Students may have an idea of words such as volts used to describe batteries and current used to describe electricity in a wire.

Add new key terms to the word wall.

Reading Icon Answers (page 113)

1. A. The water pressure is like the *voltage* in a circuit.

B. The flowing water is like the *current* in a circuit.

Reading Icon Answer (page 114)

1. A

Reading Icon Answer (page 116)

1. V

Activity Planning Notes

Use **BLM 6–3 Water Tank** as an overhead projection to discuss the material on pages 113 and 114. Then do the Find Out activity on page 115.

Ask students to identify the three illustrations at the top of page 116. Have them predict why the numbers in the triangles vary. Students have already used the term "volts" when describing batteries and light bulbs. Some students may have prior knowledge of high voltage lines. **OHT B–7 Voltmeter** may be useful when discussing this page.

The definitions of "volts" and "voltage" are quite complex. You may wish to explain these words by referring to how much energy is carried by groups of electrons, or the strength of the electric pressure. Voltage is sometimes described as a push or force. Voltage is not really a force, but this description may help some students to imagine what voltage is. **BLM 6–7 Voltage and Current in a Circuit** may be helpful in reinforcing the meaning of these two terms.

Have students complete the Show You Know! on page 118 to demonstrate their knowledge of circuits.

You can use **OHT B–8 Electric Safety Checklist** when discussing page 119.

Students could complete the checklist in **BLM 6–9 Circuit Master Certification** and bring the certificate to you to sign.

If you wish to have students make posters of the safety points from page 119, have them complete **Assessment Master 17 Poster Checklist**.

Consider using the following blackline masters and overhead transparencies in this section:

- **BLM 6–3 Water Tank**
- **BLM 6–9 Advanced Circuit Master Certification**
- **OHT B–7 Voltmeter**
- **OHT B–8 Electric Safety Checklist**

Accommodations

- If students have difficulty answering question 1 on page 113, you might tell them that the answer for one blank is current and for the other is voltage. Suggest they skim through the two paragraphs under the reading icon question, searching for the terms "current" and "voltage."
- Have students make sentences that describe the three illustrations at the top of page 116 using the terms "current" and "voltage." For example, "A current of high voltage is used to send electricity over long distances. A current of low voltage is used to power a flashlight."

Check Your Understanding Answer (page 113)

2. Current is like the flow of water through a pipe. Voltage is like the pressure of water in a tank.

Check Your Understanding Answers (page 114)

2. amperes (A)

3. The current flowing into a load is *equal to* the current flowing out of that load.

Check Your Understanding Answers (page 116)

2. volts

3. potential difference

Case Study: Positively Safe Answers (page 119)

Look for wording such as the following.

✓ Always fly kites or climb trees far away from overhead electric wires.

✓ Always be careful not to touch exposed wires.

✓ Always make sure an appliance is turned off before plugging it in.

✓ Always check that the cord is safe before using an electric device.

✓ Always remove metal jewellery before working with electric circuits.

✓ Always pull the plug, not the cord, when you are unplugging a device.

Find Out Activity (page 115)

Measuring Current in a Circuit

Purpose

- Students measure current in a circuit using an ammeter or multimeter.

Science Background

Current electricity is produced by the continuous flow of electrons. In current electricity, the electrons do not stay in any one location. They move about in a path called a circuit.

The flow of electrons in a circuit is much like the flow of water in a river. In a river it is impossible to measure the flow of one drop, and it is impossible to measure the movement of one small electron. We measure large groups of electrons instead. These groups are extremely large since the electron is so small.

An instrument called an ammeter measures the flow (or current) of electric charges. The unit used to measure current is an ampere (A). The current involves billions of electrons moving past a point. The wire conductor contains all the electrons that the circuit needs.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 days before	• Photocopy any or all of **BLM 6–4 Ammeter Scale**, **BLM 6–5 Reading an Ammeter Scale**, and **BLM 6–6 Multimeter Scales**, as well as any assessment masters you decide to use.
1 day before	• Check batteries, bulbs, and ammeters to make sure they are in working order.

APPARATUS	MATERIALS
For each group: • 6 V battery in holder • 6 V light bulb in holder • switch • 4 wires with alligator clips • ammeter or multimeter	

Suggested Timing

40 min

Safety Precautions

- Instruct students in how to connect and read the ammeter correctly.
- Be sure to check connections before students close their circuits.
- Note that the bulbs may need to be changed if a different battery is used. The important thing is to use a battery with a rating that is not more than the bulbs. For example, if a 1.5 V battery is used then the bulbs can be 1.5 V or greater. If the bulbs ratings are much higher than the rating of the power source (e.g., 3.0 V bulbs on a 1.5 V battery), then the bulbs may not light up even though the circuit is complete.
- Remind students to clean up the work area, put away all equipment, and wash their hands at the end of the activity.

Activity Planning Notes

If students will be using an analogue meter, consider using any or all of **BLM 6–4 Ammeter Scale**, **BLM 6–5 Reading an Ammeter Scale**, and **BLM 6–6 Multimeter Scales** as overhead projections or have students complete them at their desks before beginning this activity.

Demonstrate how to connect the apparatus. It is important for students to see where the alligator clips are connected and how the ammeter or multimeter is connected.

Instruct students on which scale to use on the ammeter or multimeter.

Have extra equipment on-hand in case of accidental damage.

Students could read through the activity and summarize the main idea before they begin the activity.

Accommodations

- Observe and assist as many students as possible in making their connections.

What to Do Answer (page 115)

Ammeter Position	Current
A (between battery and bulb)	Answers will vary. Same answer for A and B, about 0.3 A
B (between bulb and switch)	Answers will vary. Same answer for A and B, about 0.3 A

What Did You Find Out? Answers (page 115)

5. No

6. Students' answers will vary. Students could test their predictions by placing the ammeter before and after a closed switch.

Activity Wrap-up

- Discuss observations and answers to the What Did You Find Out? questions.
- Students could complete **Assessment Master 11 Using Tools and Equipment Checklist**.

Find Out Activity (page 117)

Measuring Voltage in a Circuit

Purpose

- Students set up a circuit and measure voltage in a circuit.

Science Background

Have you ever wondered why it is safe to touch some batteries but not the wall outlets? It is extremely dangerous to touch the insides of a wall outlet because much more energy flows through a wall outlet than through a regular 9 V battery.

You may have seen the word "volt" written on batteries (e.g., 9 V means 9 volts). A volt is a unit that measures how much energy is carried by groups of electrons.

Potential difference describes the amount of energy available to push these groups of electrons through a circuit. The term "voltage" is more commonly used instead of potential difference. Voltage or potential difference is measured in volts (V).

The energy from these groups of electrons is released to the loads. A load is anything that uses the energy, such as a CD player. The loads convert the energy that comes from the source and is carried by the electrons. For example, the energy is converted to sound in a CD player, to light in a light bulb, and to motion in a fan.

As groups of electrons flow through a circuit, they have different amounts of energy available to the loads. This is because they have previously given up some of their energy to other loads they encountered in the circuit.

A voltmeter measures the voltage or potential difference.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 days before	• Photocopy either or both of **BLM 6–6 Multimeter Scales** and **BLM 6–8 Reading a Voltmeter Scale**, as well as any assessment masters you decide to use.
1 day before	• Check batteries, bulbs, and ammeters to make sure they are in working order.

APPARATUS	MATERIALS
For each group: • 6 V battery in holder • 6 V bulb in holder • switch • 5 wires with alligator clips • voltmeter or multimeter	

Suggested Timing

40 min

Safety Precautions

- Instruct students in how to connect and read the voltmeter correctly.
- Be sure to check connections before students close their circuits.
- Note that the bulbs may need to be changed if a different battery is used. The important thing is to use a battery with a rating that is not more than the bulbs. For example, if a 1.5 V battery is used then the bulbs can be 1.5 V or greater. If the bulbs ratings are much higher than the rating of the power source (e.g., 3.0 V bulbs on a 1.5 V battery), then the bulbs may not light up even though the circuit is complete.
- Remind students to clean up the work area, put away all equipment, and wash their hands at the end of the activity.

Activity Planning Notes

If students will be using an analogue meter, consider using either or both of **BLM 6–6 Multimeter Scales** and **BLM 6–8 Reading a Voltmeter Scale** as overhead projections or have students complete them at their desks before beginning this activity.

Demonstrate how to connect the apparatus. It is important for students to see where the alligator clips are connected and how the voltmeter is connected.

Have extra equipment on-hand in case of accidental damage.

Students could read through the activity and summarize the main idea before they begin the activity.

You may want to have the students measure the voltage across the bulb first since this will yield a non-zero reading.

Accommodations

- Observe and assist as many students as possible in making their connections.

What to Do Answer (page 117)

Voltmeter Position	Voltage
A (across switch)	0 V
B (across bulb)	6.0 V (or same voltage as that of source)

What Did You Find Out? Answers (page 117)

5. Yes

6. No

7. The load converts some of the energy to another form of energy. The switch does not convert energy and therefore there is no voltage.

Activity Wrap-up

- Discuss observations and answers to the What Did You Find Out? questions.
- Students could complete **Assessment Master 11 Using Tools and Equipment Checklist**.

Ongoing Assessment

- Consider having students explain "why" for each of the electric safety points on page 119. Some students could answer orally. You could use **Assessment Master 8 Scientific Communication Rubric** to help you assess their answers.
- If students make posters of the information on page 119, use **Assessment Master 18 Poster Rubric** to assess their work.
- Consider using **Assessment Master 12 Using Tools and Equipment Rubric** to assess students' work in the Find Out activities.

Technology Links

- For more information on measuring current and voltage, go to **www.mcgrawhill.ca/books/Se9** and follow the links to Current and Voltage.

Chapter 6 Review (page 120)

SUGGESTED TIMING

40 min to complete and take up the review, and assign the Practice Test

BLACKLINE MASTERS

Master 3 Certificate
Master 4 List of Skills
BLM 6–10 Chapter 6 Word Puzzle
BLM 6–11 Chapter 6 Practice Test
BLM 6–12 Chapter 6 Test

Accommodations

- Allow students to make a chapter summary page of the key ideas/skills from the chapter. The back of the student resource provides space to do this. Alternatively, you might develop a chapter summary as an entire class.
- If students have difficulty with a particular review question, use the Review Guide to identify the section they need to review.
- **BLM 6–10 Chapter 6 Word Puzzle** can be used to help students review all of the key terms from Chapter 6.
- **BLM 6–11 Chapter 6 Practice Test** can be customized to produce extra reinforcement questions.

Using the Chapter Review

Depending on your class, students should be able to work through the review at their own pace. In order to have success with the Chapter Review, some students may need to do it in chunks, by completing several questions and then taking them up before continuing. This process will prevent students from completing many questions incorrectly.

To provide additional reinforcement of key terms, have students complete **BLM 6–10 Chapter 6 Word Puzzle**.

Once the review is completed and taken up, assign **BLM 6–11 Chapter 6 Practice Test** for students to answer individually. They may wish to use their completed review to help them.

Review Guide

Question	Section(s)	Refer to
1	6.1	Short Circuit (page 108)
2	6.3	Current in a Circuit (page 114)
3	6.3	Voltage in a Circuit (page 116)
4	6.3	Voltage in a Circuit (page 116)
5	6.3	Current in a Circuit (page 114)
6	6.2	Testing Circuits (page 110)
7 a)	6.1	Short Circuit (page 108)
7 b)	6.3	Current in a Circuit (page 114)
7 c)	6.3	Voltage in a Circuit (page 116)
8	6.1	Building Circuits (page 109)
9	6.2	Testing Circuits (page 111)
10 a)	6.3	Current in a Circuit (page 114)
10 b)	6.3	Voltage in a Circuit (page 116)

Chapter 6 Review Answers (pages 120–121)

1. **e)** short circuit

2. **c)** ammeter

3. **d)** potential difference

4. **f)** multimeter

5. **a)** ampere

6. **b)** checklist

7. **a)** T

b) F. The current flowing into a load is always equal to the current flowing out of that load.

c) F. A voltmeter measures the voltage across a component of a circuit.

8. **a)** One of the batteries should be turned around so the positive terminal of one battery is connected to the negative terminal of the other battery.

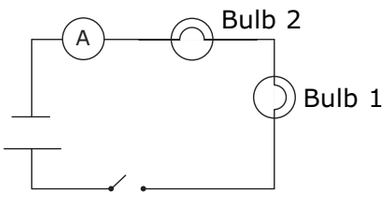
b) The last connection should be a wire to the negative terminal of a battery (not the bulb).

c) The girl should remove her metal bracelet before working with electric current.

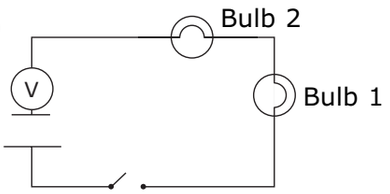
9. **a)** It is an open circuit. (There are no wires connecting the bulb and switch.)

b) The switch is turned off.

10. **a)**



b)



Summative Assessment

- Have students complete **BLM 6–12 Chapter 6 Test** to asses individual skills.
- You may wish to develop **Master 3 Certificate** to show students what they have learned during this chapter. Cut and paste the related skills from **Master 4 List of Skills**.