UNIT B Using Electric Energy

(page 98)

SUGGESTED TIMING	MATERIALS	BLACKLINE MASTERS
35–45 min including brainstorming and the Science and Media Link	• chart paper and markers	OHT B–1 Electricity

Overall Expectations

PEEV.01 – explain the generation, measurement, and conversion of electricity
SIMV.01 – explain how science-related information is presented in print and electronic media for different purposes and audiences
SIMV.02 – investigate science-related information presented in print and electronic media using appropriate research and reporting skills

Activity Planning Notes

Have students fill out the mind map on page 98 and answer question 1 on page 99. Then have students share what they have done. If they need help getting started, ask them to consider what a day at school would be like without electricity and take suggestions from the class. For example, students might have to read by kerosene lamp in a classroom heated by a fireplace or wood stove, and would not be able to use computers.

Consider producing a class mind map using **OHT B–1 Electricity**. At the end of Unit B, remind students to fill out the mind map on page 99. Have students compare the two mind maps to help assess their learning during the unit and then answer the questions they asked at the beginning of the unit.

As a class, read the Science and Media Link on page 100. Ask students to point out what types of information the cartoon conveys (e.g., news report on electricity demand, how people use energy). Ask them what issues that the cartoon raises. Also ask students to consider how effective the cartoon is at getting the audience to think about issues related to electricity (e.g., Is the use of humour effective? Does the cartoon strike a personal note?). Ask who they think is the audience for this cartoon and to explain why.

Have students complete and then discuss the follow-up questions on page 101. You may wish to have them work in small groups to develop wall charts with their work on question 4. Alternatively, if there has been a recent power outage in your community, you may wish to have students discuss that.

Consider using the following overhead transparency:
- **OHT B–1 Electricity**

Diagnostic Assessment

Brainstorming with the class should give you a sense of students' general understanding of electricity. Students may already have discussed some concepts

Accommodations

- Pair ESL and LD Learners with students who have stronger language skills.
- Students who have difficulty writing could provide answers orally.

Technology Links

- For information about the August 14, 2003 power outage, including satellite imagery of the areas affected, go to **www.mcgrawhill.ca/books/Se10** and follow the links to The Power's Out.

in previous science classes. Some things to consider:

- What do students already know?
- How familiar are students with electric circuits and wiring?
- How familiar are students with the way in which people generate and use electric energy?
- What human impacts on the environment relating to electric energy use and generation are students already aware of?

Making Connections Answers (page 101)

1. Answers may vary. Accept any reasonable explanation such as:

- With so many people using electricity for kitchen appliances, computers, air conditioners, and other devices, the power companies could not keep up, and a power outage resulted.
- A storm roared through the area and knocked down power lines.

2. Answers may vary. Sample answers:

- YES. If people had cut back on their electricity usage or if power companies had provided more electricity, there would not have been a power outage.
- NO. The electricity supply cannot keep up with the increasing demand for it.

3. Answers will vary. Sample answers:

- I could not read after dark, watch TV, or listen to the radio during the power outage.
- My home became unbearably hot (or cold), because I could not use an air conditioner (or heater).
- I could not communicate with my friends via computer.
- My family enjoyed just sitting outside and talking as we watched the storm move through.
- They sent me home from work because they had to close the store. I am going to miss being paid for those hours.

4. Answers may vary. Sample answers:

a) Public transit, such as streetcars and subways, would stop running, and streetlights would turn off, making travel after dark very dangerous; flights would also be shut down.

b) Seniors' homes would not have electricity for lighting, cooking, heating, air conditioning, and medical equipment. In addition, people might get trapped in stalled elevators.

c) Hospitals might not have enough electricity to run elevators; use life-saving medical equipment; keep lights on in the surgery or elsewhere; run fridges and freezers that store food, medicine, or blood products; run air conditioners or heating systems; prepare food; or sterilize equipment.

d) Schools would have no lighting, heating, or air conditioning, and classes would not be able to use overhead projectors, computers, or audio-visual equipment. The schools would likely close.

e) Restaurants would not have electricity to cook, run fridges and freezers, boil water, or run dishwashers, and would lose business as a result. (Note that some restaurants with gas ranges and small generators might stay open.)

f) Fridges and freezers at grocery stores would shut down, allowing food to spoil, and people would be unable to use electronically controlled cash registers.

Activity Preparation for Chapter 5

Activity/Investigation	Advance Preparation	Time Required	Other Considerations
Try This! (page 105) (TR page 125)	• 2 to 3 days before – Obtain suitable LEDs. • 1 day before – Check to make sure that wiring and clips are functional and batteries are charged. – Photocopy **BLM 5–2 Show You Know! Working with LEDs** and any assessment masters you decide to use. • Day of – Set out materials.	• 5–10 min	• Electrical supply stores often supply LEDs at a reasonable price. • Remind students not to “short” the circuit by connecting the ends of a battery to a wire. • The battery should be in a battery holder so that students do not get burned from pressing the wire ends to the poles of the battery. • Be sure to match the amperage of the batteries with that of the LEDs.
Try This! (page 108) (TR page 126)	• 2 to 3 days before – Gather materials. • 1 day before – Check to make sure that wiring and clips are functional and batteries are charged. – Photocopy **BLM 5–3 Voltage in a Circuit** and any assessment masters you decide to use. • Day of – Set out apparatus.	• 15 min	• Remind students not to “short” the circuit by connecting the ends of a battery to a wire. • Students should use alligator clips to connect the wires to the battery so that they do not burn their fingers on the wires. • Be sure to match the amperage of the batteries with that of the LEDs.
Find Out: LED Wiring Challenge! (page 109) (TR page 128)	• 2 to 3 days before – Obtain 3.0 V LEDs. • 1 day before – Obtain other apparatus. – Assemble the equipment. – Check and test the voltage of the batteries. – Photocopy any assessment masters. • Day of – Set out apparatus for each student and for teacher demonstration.	• 60 min	• Be sure to match the amperage of the batteries with that of the LEDs. • Telephone wire may be purchased in bulk. Each encased telephone wire will contain four wires. • Remind students not to “short” the circuit by connecting the ends of the battery to a wire. • The batteries should be in battery holders and students should use clips to attach wires to the batteries.
Find Out: Energy Conversion Collage (page 111) (TR page 132)	• 1 to 2 days before – Gather a selection of magazines. – Gather other materials. – Photocopy any assessment masters. • Day of – Set out materials.	• 60 min	• Have ready some good sample collages.
Find Out: All Kinds of Energy (page 112) (TR page 134)	• 1 day before – Gather materials and apparatus. Assemble and test all electric equipment. – Photocopy **BLM 5–4 All Kinds of Energy** and any assessment masters you decide to use. • Day of – Set out materials.	• 60 min	• The battery should be in a battery holder and students should use clips. • Remind students to keep their fingers away from moving parts on the device. • Plastic fan blades are quite sharp. You may wish to have students build their own. • Remind students not to “short” the circuit by connecting the ends of a battery to a wire.
Find Out: LED Home Audit (page 118) (TR page 139)	• 1 day before – Collect some examples of electric devices with LEDs.	• 5 min to introduce activity; 30–45 min for audit; 15 min to take up questions	• If some students are unable to complete the LED audit at home, you could provide each with a copy of **BLM 5–7 LED Home Audit**.
Try This! (page 119) (TR page 140)	• 2 to 3 days before – Obtain one or more regular pen flashlights and LED flashlights. – Obtain flashlight batteries. – Test the flashlights. • Day of – Bring the flashlights to class.	• 15 min	• Caution students not to move around the classroom when the lights are off. • Pair students with visual impairments with those who can describe the results.

Materials Needed for Chapter 5

Activity/Investigation	Apparatus	Materials	Blackline Masters
Try This! (page 105) (TR page 125)	• 1.5 V battery in a battery holder (1 set per pair) • wires with alligator clips (4 sets per pair) • LED requiring 1.5 V or more (1 per pair)		**Recommended** BLM 5–2 Show You Know! Working With LEDs Assessment Master 7 Safety Checklist Assessment Master 8 Safety Rubric **Optional** Assessment Master 9 Using Tools and Equipment Checklist Assessment Master 10 Using Tools and Equipment Rubric
Try This! (page 108) (TR page 126)	• 1.5 to 3 V battery in holder (1 set per pair) • 1.5 V LEDs or bulbs in holders (2 sets per pair) • switch (1 per pair) • wires with alligator clips (6 sets per pair) • voltmeter, digital if possible (1 per pair)		**Recommended** BLM 5–3 Voltage in a Circuit Assessment Master 7 Safety Checklist Assessment Master 8 Safety Rubric
Find Out: LED Wiring Challenge! (page 109) (TR page 128)	• 1.5 V C-cell batteries in holders (2 sets per pair) • wires with alligator clips (5–7 sets per pair) • 3.0 V LEDs (2 per pair) • 1 switch • voltmeter, digital if possible (1 per pair) • wire strippers (optional,1 for class)		**Recommended** Assessment Master 7 Safety Checklist Assessment Master 8 Safety Rubric **Optional** Assessment Master 9 Using Tools and Equipment Checklist Assessment Master 10 Using Tools and Equipment Rubric
Find Out: Energy Conversion Collage (page 111) (TR page 132)	• scissors (1 pair per student) • markers (1 set per group) • computer and printer (optional, 1 or more for class)	• magazines (3 per group or enough for class to share) • bristolboard (1 piece per group) • glue stick (1 per group) • printer paper or blank labels (optional)	**Optional** Assessment Master 1 Co-operative Group Work Checklist Assessment Master 2 Co-operative Group Work Rubric Assessment Master 13 Oral Presentation Checklist Assessment Master 14 Oral Presentation Rubric Assessment Master 15 Visual Presentation Checklist Assessment Master 16 Visual Presentation Rubric
Find Out: All Kinds of Energy (page 112) (TR page 134)	• 1.5 V C-cell batteries (2 per pair) • LED 3 V or more (1 per pair) • wires with alligator clips (5–7 sets per pair) • electric motor (1 per pair) • electric switch (1 per pair) • fan and stand (1 per pair) • voltmeter or multimeter (1 per pair) • scissors (1 per pair, if making fan blades)	• 30 cm by 30 cm sheet of bristolboard or cardboard (1 per pair, if making fan blades)	**Recommended** BLM 5–4 All Kinds of Energy Assessment Master 7 Safety Checklist Assessment Master 8 Safety Rubric **Optional** Assessment Master 1 Co-operative Group Work Checklist Assessment Master 2 Co-operative Group Work Rubric
Find Out: LED Home Audit (page 118) (TR page 139)	• electric devices with LEDs		**Optional** BLM 5–7 LED Home Audit
Try This! (page 119) (TR page 140)	• regular (incandescent bulb) flashlight (1 or more) • LED flashlight (1 or more)		

CHAPTER 5 Electricity and You

(page 102)

SUGGESTED TIMING
10 min

Overall Expectations

PEEV.01 – explain the generation, measurement, and conversion of electricity
PEEV.03 – analyze the social, economic, and/or environmental implications of the sources and uses of electrical energy

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the key terms:

- Write definitions for the two key terms in their Science Log. You may wish to have students keep a glossary at the back of their Science Log.
- Write a paragraph that contains the two key terms. You may wish to provide a framework such as the following one.
  Energy can makes things move. Some examples of energy making things move include:
  Electricity can make things move. I use electricity to make things move when:

Help students remember the key terms by posting them on a science word wall or electricity bulletin board.

Activity Planning Notes

Have a class brainstorming session to find out what students already know about how electricity is used.

Have students read the Chapter 5 opener and answer question 1. Connecting students' personal experiences to their learning is one way to tap into their motivation.

Check Your Understanding Answer (page 102)

1. Answers will vary depending on students' experiences. Look for three devices such as: lights, MP3 players, video games, and computers.

5.1 Understanding Electric Energy

(page 103)

SUGGESTED TIMING	MATERIALS	BLACKLINE MASTERS
45 min 5–10 min for Try This! on page 105 15 min for Try This! on page 108 60 min for Find Out: LED Wiring Challenge	• markers • large flashlight or car battery	BLM 5–1 Understanding Electric Energy OHT B–2 Parts of a Circuit and Circuit Symbols OHT B–3 Measuring Current

Specific Expectations

PEE1.02 – define and describe electrical concepts and their units
PEE2.01 – locate and select information from various sources to identify factors affecting generation and use of electricity
PEE2.05 – communicate information using appropriate formats for specific purposes and audiences

Science Background

Light emitting diodes (LEDs) are small, durable, and extremely energy efficient. In an LED, electric current flows in one direction, from the anode, through a semiconductor material housed in a plastic bulb, to the cathode. As electric current flows through it, the LED glows. A tiny reflector redirects the emitted light into a beam.

Coloured LEDs are used as indicator lights in electric devices and for digital alarm clock displays. White LEDs were invented relatively recently. White LEDs are used in specialized reading lamps and flashlights.

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the key terms:
- Write definitions for these terms in their Science Log. You may wish to have your students keep their own glossary at the back of their Science Log.
- Appropriately use the key terms as many times as possible in two minutes. Students could work in pairs, with one partner talking and the other listening. After two minutes, the partners should switch roles.

Help students remember the key terms by posting them on a science word wall or electricity bulletin board.

Reading Icon Answers (page 104)

1. **a)** Check that students have circled each circuit symbol and highlighted what the symbols represent.

   b) The two symbols indicate whether an electric circuit is closed or open.

Reading Icon Answers (page 106)

1. Students should highlight amperes (A).

Reading Icon Answers (page 107)

3. 0.4 A of current is flowing in the electric circuit.
4. Students should highlight volts (V).

Reading Icon Answer (page 108)

1. Students should place a + where the electric current enters the load and a – where the electric current leaves the load. The load will drain some of the electric energy as it passes through.

Activity Planning Notes

You can use **BLM 5–1 Understanding Electric Energy** for formative as well as summative assessment of major concepts and terms covered in Section 5.1. If you use the blackline master as a pre-test, let students know that they will have a chance to check their answers later. After they have completed the section, have students re-evaluate the answers they recorded earlier on the blackline master.

Draw students' attention to the drawing of an electric circuit on page 103. Point out that electric current flows towards positive charges and away from negative charges. You may wish to show students the direction of the current in a large flashlight or car battery.

You may wish to have students work in groups of three or four to complete pages 103–108. This material reviews principles covered in the Grade 9 science program. You may wish to use **OHT B–2 Parts of a Circuit and Circuit Symbols** during this reviw and **OHT B–3 Measuring Current** when discussing current. Discuss students' answers to all of the questions before students proceed to Section 5.2. Provide students with personalized feedback so that they can assess their own progress. Point out to them their successes to foster motivation.

Use the two Try This! activities to reinforce semi-concrete concepts. Students can work in groups to complete each activity. Students will review how to build an electric circuit and become familiar with light emitting diodes (LEDs) during the Try This! activity on page 105. Students will practice drawing circuit diagrams and building more complicated electric circuits during the Try This! activity on page 108.

Use the Find Out activity on page 109 to familiarize students with series circuits and parallel circuits, and to give them practice building electric circuits.

Consider using the following blackline master and overhead masters:

- **BLM 5–1 Understanding Electric Energy**
- **OHT B–2 Parts of a Circuit and Circuit Symbols**
- **OHT B–3 Measuring Current**

Accommodations

- Some students will not immediately generalize learning experiences to other learning situations. Draw attention to the connections between concepts covered in hands-on activities and described in written text.
- Some students are easily distracted. Use study carrels to provide a learning environment in which students can concentrate.

Technology Links

- Although this section reviews concepts from the Grade 9 science program, some students may require additional reinforcement. For interactive online modules, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Learning About Electricity.

Check Your Understanding Answer (page 103)

2. An electric circuit is a pathway for the flow of an electric current.

Making Connections Answer (page 103)

3. When the electric current stops flowing, the light goes out.

Check Your Understanding Answers (page 105)

2. The symbol represents a load such as a light bulb.

3. NO. Electric current will not flow because the circuit is not closed.

Making Connections Answer (page 105)

4. An electric circuit is a pathway for the flow of an electric current.

Making Connections Answers (page 107)

3. Look for the following order. The order, from most electric current to least electric current is:
d) 1 electric kettle

c) 2 microwave oven

b) toaster

a) lamp

5. Use a voltmeter to measure the voltage across each battery. (The positive connection from the voltmeter should be connected to the positive end of the battery, and the negative connection from the voltmeter connected to the negative end of the battery.)

Check Your Understanding Answers (page 108)

2. a) Students should write an “A” on the small balls in the wheelbarrow, and a “V” on the person pushing it.

b) Wording will vary. Sample answer:

- Amperes relate to amount of current. Voltage relates to amount of “push.”
- Amperes describe the amount of electric current flowing in an electric circuit. Therefore, the small balls in the wheelbarrow represent amperes. The voltage is the amount of “push” an electric current has. Therefore the person who pushes the wheelbarrow represents volts.

Try This! Activity (page 105)

Purpose

- Students practise wiring an electric circuit.
- Students reinforce their understanding of the following key terms: conductor, electric circuit, electric current, light emitting diode (LED), load, source, and switch.

Science Background

An electric circuit consists of a source, conductors, a load, and, typically, a switch. In this case, the load is an LED. LEDs like dry cell batteries are polarized; electric current always leaves the negative pole, or anode, and returns to the positive pole, or cathode.

The two wires protruding from each LED are of different lengths. The long wire is the positive lead and the short wire is the negative lead.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 to 3 days before	• Obtain suitable LEDs. Electrical supply stores often supply LEDs at a reasonable price.
1 day before	• Check to make sure that wiring and clips are functional and batteries are charged. • Photocopy **BLM 5–2 Show You Know! Working with LEDs** and any assessment masters you decide to use.
Day of	• Set out materials.

APPARATUS	MATERIALS
• 1.5 V battery in a battery holder (1 set per pair) • wires with alligator clips (4 sets per pair) • LED requiring 1.5 V or more (1 per pair)	

Suggested Timing

5–10 min

Safety Precautions

- Remind students not to “short” the circuit by connecting the ends of a battery to a wire.
- The wire that is attached to the battery can become quite hot. The battery should be in a battery holder so that students do not get burned from pressing the wire ends to the poles of the battery.

Activity Planning Notes

Use the activity to reinforce the semi-concrete concepts discussed on pages 103–105. Introduce the activity as a wiring challenge. Ask students, “What do you have to do to make the LED light up?”

Have students work with a partner. Discuss what an LED is, and hand one out to each pair to examine.

Demonstrate how to use the alligator clips to attach a wire to a battery and to an LED. The voltage of the battery must be less than the voltage of the LED so that the LED is not damaged.

Have one student from each pair get a set of apparatus. The amount of wiring students need depends on the equipment available. Some multimeters have their own wires. Students will discover that LEDs are polarized and therefore can only be connected to the battery in one direction: positive lead to positive lead and negative lead to negative lead. Have students refer to **BLM 5–2 Show You Know! Working with LEDs**.

Accommodations

- Circulate around the class so that you can spot and assist those who need help. Ask struggling students to point out the negative and positive ends of the battery and LED.

Activity Wrap-up

- Check students’ circuits and sign their Show You Know! mastery certificates.
- On the chalkboard, draw a schematic diagram of the electric circuit based on input from the students. Use the circuit symbols shown on page 104 of the student resource.
- Check to see that students are connecting their learning from the activity to the concepts in the student resource by asking questions such as:
  – What part of the electric circuit provided the electric current?
  – How did you start and stop the flow of electric current in your circuit? What could you do to make it easier to turn the flow off and on?
  – In your circuit, identify the load, conductor, and switch (if there was a switch).

Try This! Activity (page 108)

Purpose

- Students construct a simple electric circuit with one dry cell battery, a switch, and two light bulbs or LEDs.
- Students measure voltage across a load in an electric circuit.

Science Background

In a series circuit, the source must provide enough voltage for more than one load. For example, one 3 V battery has enough voltage to supply two 1.5 V light bulbs. Since each load will drain some of the energy provided by the current, the voltage will drop across each load in the circuit.

Taking voltage measurements is a useful skill in everyday life. It may be important to measure the voltage of a car battery, for example, in order to check for a short or unexpected drain on the electric circuit.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 to 3 days before	• Gather materials.
1 day before	• Check to make sure that wiring and clips are functional and batteries are charged. • Photocopy **BLM 5–3 Voltage in a Circuit** and any assessment masters you decide to use.
Day of	• Set out apparatus for each student pair and for teacher demonstration.

APPARATUS	MATERIALS
• 1.5 to 3 V battery in holder (1 set per pair) • 1.5 V LEDs or bulbs in holders (2 sets per pair) • switch (1 per pair) • wires with alligator clips (6 sets per pair) • voltmeter, digital if possible (1 per pair)	

Suggested Timing

15 min

Safety Precautions

- Remind students not to "short" the circuit by connecting the ends of the battery to a wire.
- Students should use alligator clips to connect the wires to the battery so that they do not burn their fingers on the wires.

Activity Planning Notes

Be sure to match amperage of the batteries to that of the LEDs. Using higher voltage LEDs or bulbs or lower voltage batteries will work, but the light produced will be dim. You may wish to introduce the activity as soon as students have finished the Try This! activity on page 105. Otherwise, introduce the activity after students have completed the questions on page 108.

Introduce the activity as another wiring challenge. Draw the electric circuit diagram for the circuit on the chalkboard and explain that this diagram is a blue print for building the electric circuit. Write relevant key terms: ammeter, amperes (A), potential difference, voltmeter, and volts (V).

Demonstrate how to hook up the voltmeter around a light bulb (or LED) in an electric circuit. As shown in the diagram, the negative lead of the voltmeter should be to the left of the light bulb to be tested. If students are using LEDs, the negative lead of the voltmeter should be connected to the negative lead of the LED. The positive lead of the voltmeter should be to the right of the light bulb, or connected to the positive lead of the LED.

Have students work in pairs. Provide each student with a copy of **BLM 5–3 Voltage in a Circuit** and a set of apparatus, and have them build their circuits. You may wish to have students use **OHT B–4 Building Circuits Checklist** to check their work. Circulate around the room to check that students know where to connect the voltmeter to measure the voltage across Bulb 2.

Have students record the voltage readings in their student resource and in a table on the chalkboard.

Accommodations

- Pair stronger students with those students who need extra help and guidance.
- Pair visually impaired students with those who can easily read the voltmeter.
- Pair students with dexterity problems with those without such difficulties.

Activity Wrap-up

- Discuss the results as a class. Prompt students to explain why the voltage across Bulb 2 was less than the total voltage provided by the battery. Ask students to predict what the voltage would be across Bulb 1 in the electric circuit.
- Discuss variations among the results and identify possible explanations. For example, variations in voltage in different electric circuits could be due to variation in the age of the batteries, type and length of wires, and type of bulbs.

Find Out Activity (page 109)

LED Wiring Challenge!

Purpose

- By building an electric circuit, students apply the knowledge they developed in Section 5.1 and develop their inquiry skills.
- Students compare and contrast series circuits and parallel circuits.

Science Background

A series circuit provides only one pathway for electric current, and thus the current will be the same along the entire circuit. The total voltage across all loads in the circuit is equal to or less than the total voltage provided by all of the sources added together. The voltage drops across each load in the circuit. All components along a series circuit are controlled by a single switch. If one of the components stops working, such as when a bulb burns out, the component acts like a switch and stops the flow of electric current.

A parallel circuit provides more than one pathway for electric current. The total amount of current is split among the branches of the pathway. If there is one load per branch, the voltage drop across each load in the circuit will be the same. Unlike a series circuit, it is possible to shut down one branch in a parallel circuit and stop the electric current to one load at a time.

A combination circuit includes both series and parallel connections. For example, two batteries in a circuit could be arranged in series, while two bulbs could be arranged in parallel.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 to 3 days before	• Obtain 3.0 V LEDs. If you substitute lower voltage LEDS, match the total voltage of the two batteries accordingly.
1 day before	• Obtain other apparatus. • Assemble and test the equipment. • Check the voltage of the batteries to ensure that they are charged. • Photocopy any assessment masters you decide to use.
Day of	• Set out apparatus for each student pair and for teacher demonstration.

APPARATUS	MATERIALS
• 1.5 V C-cell batteries in holders (2 sets per pair) • wires with alligator clips (5–7 sets per pair) • 3.0 V LEDs (2 per pair) • 1 switch • voltmeter, digital if possible (1 per pair) • wire strippers (optional, 1 for class)	

Suggested Timing

60 min

Safety Precautions

- Remind students not to “short” the circuit by connecting the ends of the battery to a wire.
- The wire that is attached to a battery can become quite hot. The batteries should be in battery holders and students should use clips to attach wires to the batteries.

Activity Planning Notes

Note that electrical supply stores often supply LEDs at a reasonable price. The amount of wiring students need depends on the equipment available. Some multimeters have their own wires attached.

This activity can be used as a summative task for Section 5.1. The activity also reviews series circuits and parallel circuits, which were covered in the Grade 9 science program. Consider providing students with a performance rubric based upon expected outcomes for this activity.

Demonstrate how to hook up and read the voltmeter. Then have students work in pairs to complete the activity.

Remind students that each LED will need 3.0 V of electricity. You may wish to have students complete their circuit diagrams and then show them to you. Alternatively, you could draw the appropriate circuit diagram on the chalkboard for students to copy as you give instructions for the activity.

Students will discover that the LEDs will get enough voltage only when the LEDs are arranged in parallel, as shown on the diagram on page 109.

Circulate around the class to ensure students are using the voltmeter correctly. If the leads are hooked up on the wrong sides of the load, the reading will be negative.

If students are having difficulty predicting the voltage across the batteries, have them measure the voltage across one battery at a time. Then ask them to predict the voltage across two 1.5 V batteries arranged in a series. The voltage reading across the two batteries in a series will be 3.0 V.

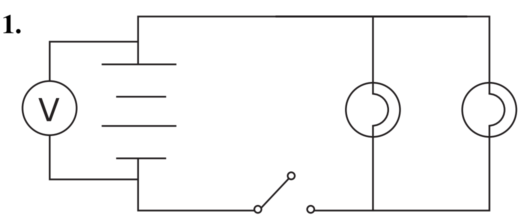
Remind students to note their observations in the student resource as they work through the activity.

Accommodations

- Pair stronger students with those students who need extra help and guidance.
- Pair visually impaired students with those who can easily read the voltmeter.
- Pair students with dexterity problems with those without such difficulties.
- Some students may need additional reinforcement to process the information and the instructions. Provide a checklist that outlines the steps of the activity or ask students to restate the instructions to you. Alternatively, such students could be paired with students who have stronger skills.

What Did You Find Out? Answer (page 109)

1.



7. The circuit will function only if the two LEDs are connected in parallel. If the two LEDs are in series, they will not receive enough voltage to light up. Students may mention this if they tried to put the LEDs in series.

Activity Wrap-up

- Consider having students present the completed electric circuits to the class and describe what they had to do to make both LEDs light up.

- You may wish to use a summary table, such as the one below, to compare and contrast series circuits and parallel circuits. Have students provide input for the second and third columns as you complete the table on the chalkboard or an overhead.

OBSERVATION OF CIRCUIT	SERIES CIRCUIT	PARALLEL CIRCUIT
Do loads share the voltage?	Yes. Adding loads decreases the amount of voltage that each load receives.	No. Each load obtains the full voltage from the electric energy source.
Are all loads turned on or off at the same time?	Yes.	No. You can turn one load off without affecting other loads in the circuit.

- Connect students' learning to their daily lives. For example, ask if they would use a parallel circuit or a series circuit to wire a kitchen, and to explain why. A parallel circuit allows someone to turn on lights one at a time and use plug outlets individually.
- Use students' circuits and answers to question 7 to assess their understanding of series and parallel circuits.

Ongoing Assessment

- Assess students' responses to the Reading Icon, Check Your Understanding, and Making Connections questions throughout the section.
- Use **Assessment Master 7 Safety Checklist** and **Assessment Master 8 Safety Rubric** to foster and assess students' awareness of safety precautions during the Try This! on page 105 and the Find Out activity.
- Use **Assessment Master 10 Using Tools and Equipment Rubric** to assess how effectively students handled the equipment. Have students use **Assessment Master 9 Using Tools and Equipment Checklist** for self-assessment during the Try This! activity on page 105 and the Find Out activity.
- Assess students' understanding of voltage in electric circuits by checking their responses on **BLM 5–3 Voltage in a Circuit**.

Alternative Activity

- Show the video or DVD called *Electrical Curren*t, Bill Nye, The Science Guy (Magic Lantern Communication Ltd.).

Technology Links

- For online activities that help reinforce students' understanding of electric energy concepts, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Electric Energy Activities.

5.2 What Is Electricity Good for?

(page 110)

SUGGESTED TIMING	MATERIALS
10 min 60 min for Find Out: Energy Conversion Collage 60 min for Find Out: All Kinds of Energy	• electric devices such as a hair dryer, flashlight, radio, and fan

Specific Expectations

PEE1.04 – identify the range of uses for electrical energy in our society and the energy conversions involved
PEE2.01 – locate and select information from various sources to identify factors affecting generation and use of electricity
PEE2.05 – communicate information using appropriate formats for specific purposes and audiences

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the key term:
- Write definitions for the term in their Science Log. You may wish to have students keep their own glossary at the back of their Science Log.
- Write a sentence that contains the key term.

Help students to remember the key term by posting it on a science word wall or electricity bulletin board.

Reading Icon Answer (page 110)

1. A CD player converts electric energy into sound energy. Students may say that a CD player also converts electric energy into mechanical energy, as an electric motor turns the CD.

Activity Planning Notes

Introduce Section 5.2 by bringing various electric devices, such as a hair dryer, flashlight, radio, and fan to the classroom. Turn on each device and demonstrate the conversion of electric energy into different forms of energy.

Have students predict answers to question 1 on page 110. Then, as a class, read the rest of the page together.

Have students complete and then discuss the questions on page 111 before moving on to the Find Out activity. This activity draws on students' prior knowledge and helps them connect the subject matter with personal experience.

The Find Out activity on page 112 involves building an electric circuit that includes two different energy conversion devices.

Accommodations

- Pair students with stronger reading and comprehension skills with those students who require extra guidance.
- Pair ESL and LD Learners with a reading partner. They can take turns reading aloud the questions.
- Use various learning modalities to present the material in order to engage students with different learning styles. Reinforce the semi-concrete discussion of electric energy conversions using auditory, visual, and tactile forms of presentation.

Check Your Understanding Answer (page 111)

2. Energy conversion is the process of changing one form of energy into another. Look for one example such as converting electric energy from a flashlight battery to light.

Making Connections Answers (page 71)

3. **a)** electric energy → light bulb → light or light energy

   b) electric energy → light bulb → heat or heat energy

Find Out Activity (page 111)

Energy Conversion Collage

Purpose

- Students create a collage to demonstrate their knowledge of energy conversions.
- Students consider the importance of electric energy to daily life.

Science Background

According to the first law of thermodynamics, energy cannot be created or destroyed, but it can be transformed from one form to another. In the student resource, the process of energy transformation is described as energy conversion. In order for electric energy to be useful, it must be converted into a different form of energy, such as movement (mechanical energy), light, heat, or sound.

According to the second law of thermodynamics, no energy transformation is 100% efficient. This means that as energy is converted from one form to another, some of the useful energy is lost. This energy is not destroyed, but is converted to disordered heat energy, which disperses in the environment. Disordered energy, or entropy, cannot be used for work.

When electric devices convert electric energy into useful forms, some energy is also converted to disordered energy.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
1 to 2 days before	• Gather a selection of magazines that will appeal to various interests (e.g., sports, fashion, fishing). • Gather scissors, markers, bristolboard, and glue sticks. • Photocopy any assessment masters you decide to use.
Day of	• Set out materials.

APPARATUS	MATERIALS
• scissors (1 pair per student) • markers (1 set per group) • computer and printer (optional, 1 or more for class)	• magazines (3 per group or enough for class to share) • bristolboard (1 piece per group) • glue stick (1 per group) • printer paper or blank labels (optional)

Suggested Timing

60 min

Safety Precautions

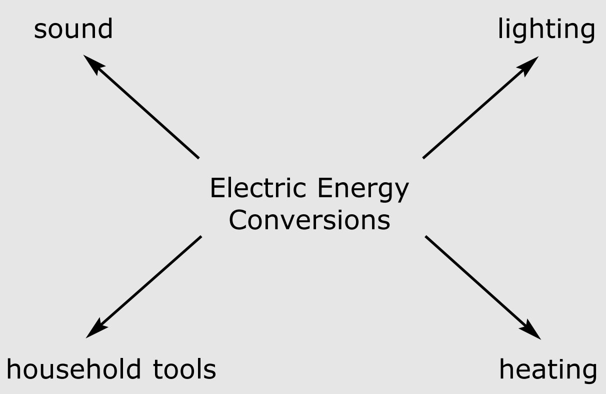
- Remind students to be careful with scissors.

Activity Planning Notes

Introduce the activity and explain how student work will be assessed. Be clear about the number of images each student should find (e.g., three to five). You may wish to have students do library or Internet research to find out more about energy conversion by a particular electric device. If so, book the library or computer lab in advance.

Flip through a magazine and point out some suitable energy conversion images that students could use, such as car headlights (light energy from electric energy), a toaster (heat from electric energy), a stereo speaker (sound from electric energy), or a washing machine (movement from electric energy).

Consider showing some examples of effective collages before explaining how to create a web storm. Draw a framework on the chalkboard with the main topic (electric energy conversion) in the centre. Different categories of energy use branch out from the centre to create a web. Explain that the collage creates a storm around the web.



Have students work in groups of four or more to complete their collages. Assign a category to each student so that everyone in a group is working on one branch of the web. Alternatively, each student group could work on one branch of the web. In that case, post the completed collages on the wall around the central heading, "Electric Energy Conversions," to complete the web storm.

Have each group present their collage to the class. Each group member should participate in the presentation.

Accommodations

- Pair students with visual impairments with other students or provide an alternative format, such as a poem or song.
- Students with attention difficulties may go off task. You might supervise such students more closely by asking what images they are choosing and why.

What Did You Find Out? Answer (page 111)

4. Students should explain why each image belongs with a certain category and what kind of energy conversion is taking place. Some images may be placed in more than one category, such as a CD player, which converts electric energy to mechanical energy and sound energy.

Activity Wrap-up

- Post the collages on a bulletin board or a classroom wall.
- Ask students to name an example of electric energy conversion from another group's presentation that they had not considered before or that is important in their daily lives.

Find Out Activity (page 112)

All Kinds of Energy

Purpose

- Students design and build an electric circuit that converts electric energy into light and mechanical energy.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
1 day before	• Gather materials and apparatus. Assemble and test electric equipment, including motors, switches, batteries, LEDs, as well as voltmeters or multimeters. • Photocopy **BLM 5–4 All Kinds of Energy** and any assessment masters you decide to use.
Day of	• Set out materials.

APPARATUS	MATERIALS
• 1.5 V C-cell batteries (2 per pair) • LED, 3 V or more (1 per pair) • wires with alligator clips (5–7 sets per pair) • electric motor (1 per pair) • electric switch (1 per pair) • fan and stand (1 per pair) • voltmeter or multimeter (1 per pair) • scissors (1 per pair, if making fan blades)	• 30 cm by 30 cm sheet of bristolboard or cardboard (1 per pair, if making fan blades)

Suggested Timing

60 min

Safety Precautions

- Remind students to keep their fingers away from moving parts on the device.
- Remind students not to "short" the circuit by connecting the ends of a battery to a wire.
- The wire that is attached to the battery can become quite hot. The battery should be in a battery holder and students should use clips so that they do not burn their fingers.
- Plastic fan blades are quite sharp. You may wish to have students build their own fans by cutting blades out of cardboard or bristolboard and attaching them to the motor output shaft.

Activity Planning Notes

Before introducing the activity, test the equipment and decide how students should arrange the loads in the electric circuit. Probably the two loads will have to be arranged in parallel. The two 1.5 V batteries should be arranged in series in order to produce 3.0 V total. If you substitute lower voltage LED be sure to reduce the battery voltage accordingly.

Introduce the activity and summarize the steps. Review how to use a voltmeter (or multimeter). The amount of wiring students need depends on the equipment available. Some multimeters have their own wires attached.

Have students work in pairs to answer questions 1 and 2 on page 112. Check their work, provide feedback, and recheck if need be. Give students permission to build their circuits only when you are satisfied with their written work.

Circulate around the classroom. Remind students that if the voltmeter is showing a negative or zero voltage, the connections of the voltmeter to the electric circuit should be switched.

Accommodations

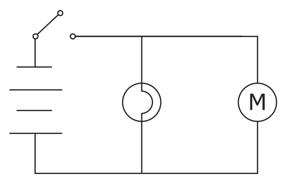
- Pair stronger students with those students who need extra help and guidance.
- Pair visually impaired students with those who can easily read the voltmeter.
- Pair students with dexterity problems with those without such difficulties.

Activity Wrap-up

- Have students complete and then discuss the chart on page 112, and demonstrate their working electric circuits to the class. It is likely that different groups will have different working arrangements.
- Have students complete and then discuss **BLM 5–4 All Kinds of Energy**.

What to Do Answer (page 112)

1. The best arrangement is to have the batteries in series and the loads in parallel as shown. However, some students may design and test a circuit with the loads in series and adapt their design in step 4.



2. **a)** and **b)** Accept any two reasonable safety precautions. For example:
   - Do not get the equipment wet.
   - Do not touch the ends of the wires.

What Did You Observe? Answers (page 112)

a) 3.0 V

b) 2.9 to 3.0 V

c) 2.8 to 3.0 V

Alternative Activity

- Use some or all of the activities in the following Physics *ActiveFolders*: The Law of Conservation of Energy.

Ongoing Assessment

- Use questions 2 and 3 on page 111 to assess student understanding of the concept of energy conversion.
- Use **Assessment Master 2 Co-operative Group Work Rubric** to assess how well students worked together during the Find Out activities.
- Have students assess their own work during Find Out: Energy Conversion Collage by using **Assessment Master 1 Co-operative Group Work Checklist**, **Assessment Master 13 Oral Presentation Checklist**, or **Assessment Master 15 Visual Presentation Checklist**.
- Use **Assessment Master 14 Oral Presentation Rubric** or **Assessment Master 16 Visual Presentation Rubric** to assess students' collages in Find Out: Energy Conversion Collage.
- Use **Assessment Master 8 Safety Rubric** to assess students' attention to safety precautions during Find Out: All Kinds of Energy.
- Have students assess their own work during Find Out: All Kinds of Energy by using **Assessment Master 1 Co-operative Group Work Checklist** and **Assessment Master 7 Safety Checklist**.
- Use **BLM 5–4 All Kinds of Energy** to assess students' understanding of electric circuits and energy conversion.

5.3 The Power of Electricity (page 113)

SUGGESTED TIMING	MATERIALS	BLACKLINE MASTERS
45 min for introduction and Science and Math Link on page 114 45 min for Science and Math Link on page 116 45–60 min for Find Out: LED Home Audit 15 min for Try This!	• markers • selection of incandescent light bulbs with various power ratings (optional) • reading lamp (optional)	BLM 5–5 Calculate the Power Used BLM 5–6 Calculate Your Cost OHT B–3 Measuring Current OHT B–5 and B–6 Calculate the Power Used OHT B–7 and B–8 Calculate Your Cost

Specific Expectations

PEE1.02 – define and describe electrical concepts and their units
PEE1.03 – determine quantitatively and/or qualitatively the energy and power associated with electrical devices
PEE1.04 – identify the range of uses for electrical energy in our society and the energy conversions involved
PEE2.04 – determine and record the electrical energy and power of electrical devices

Science Background

Power is a rate that describes the amount of energy used, in joules (J), over time, in seconds (s). The watt (W) is the unit of measurement for power (P), thus the wattage of an electric device is a power rating.

Power suppliers tend to charge for electric energy by the kilowatt hour (kWh), which is the total amount of energy needed to supply 1000 W, or 1 kW, for one hour.

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the key terms:
- Write definitions for these terms in their Science Log. You may wish to have your students keep their own glossary at the back of their Science Log.
- Create a concept map with the key terms.

Help students remember the key terms by posting them on a science word wall or electricity bulletin board.

Reading Icon Answers (page 113)

1. Students should highlight: the amount of energy used in a certain period of time.
2. Students should circle 100 W.

Activity Planning Notes

Measuring the use and cost of electric energy are abstract concepts. Provide concrete examples of electric devices with different power ratings. For example, show students a selection of incandescent light bulbs with various power ratings and compare the amount of light produced by each bulb. You might turn off the overhead lights and use a reading lamp to test the different bulbs. Explain that the higher wattage bulbs require more electric energy.

Review the concepts of voltage and current size, which were covered in Section 5.1. Refer to **OHT B–3 Measuring Current**, which compares voltage to the "push" supplied by a pump, electric current to the water flowing through the tubes in a fish tank filter, and power to the tubes in a fish tank filter. Label the diagram using the terms volts, amperes, and watts as you review the analogy with students.

As a class, read page 113 and have students complete and then discuss question 3.

Introduce the concept of joules (J). Give examples of measurements in joules. For example, a hard pretzel contains about 8000 J of food energy; it takes about 10 J to lift an apple to the mouth.

Have students use a "think-pair-share" strategy to complete the Science and Math Link on page 114. Have students work through the steps on their own, and then in pairs. When each pair has solved the practice problems, have them team with another pair to share their work. As a class, discuss the solutions to the questions on pages 114–115 using **OHT B–5** and **B–6 Calculate the Power Used**.

Distribute **BLM 5–5 Calculate the Power Used**, which provides additional problems for students to solve on their own. Assess student work before moving on to the next section.

Introduce the concept of kWh and give concrete examples. For example, a large clothes dryer uses more electric energy than a small one. Therefore, a large clothes dryer uses more kWh.

You may wish to use a "think-pair-share" strategy to have students complete the Science and Math Link on page 116. As a class, take up the solutions to the questions on pages 116–1117 using **OHT B–7** and **B–8 Calculate Your Cost**.

Distribute **BLM 5–6 Calculate Your Cost**, which provides additional problems for students to solve on their own.

Students will consider practical aspects of energy-use comparisons in the Find Out activity on page 118 and the Try This! activity on page 119.

Accommodations

- Provide students with calculators if they do not have their own.
- Pair students with weak math skills with stronger students.

Consider using the following blackline masters and overhead transparencies:

- **BLM 5–5 Calculate the Power Used**
- **BLM 5–6 Calculate Your Cost**
- **OHT B–3 Measuring Current**
- **OHT B–5 and B–6 Calculate the Power Used**
- **OHT B–7 and B–8 Calculate Your Cost**

Check Your Understanding Answers (page 113)

3. a) An electric device with a high *power* rating will use a lot of *electric* energy.

b) A 20 *W* light bulb takes less power than a 60 *W* light bulb.

Calculate the Power Used Answers (pages 114–115)

1. **STEP 1:** Energy = 7500 J, Time = 5 s

STEP 2: How much *power* is produced.

STEP 3: $\text{Power} = \dfrac{7500\ \text{J}}{5\ \text{s}}$

$= 7500 \div 5 = 1500$

STEP 4: The power rating of the hand dryer is 1500 W.

2. **STEP 1:** Energy = 1020 J, Time = 60 s,

$\text{Power} = \dfrac{\text{Energy}}{\text{Time}}$

STEP 2: How much power is produced.

STEP 3: $\text{Power} = \dfrac{\text{Energy}}{\text{Time}}$

$= \dfrac{1020\ \text{J}}{60\ \text{s}}$

$= 1020 \div 60 = 17$

STEP 4: The power rating of the LED traffic light is 17 W.

Calculate Your Cost Answers (pages 116–117)

STEP 6: 1.8

1. a) **STEP 1:** Power = 700 W, Time = 3 h

STEP 2: How much *energy* is used.

STEP 3: 700 W ÷ 1000 = 0.7 kW

STEP 4: Energy used = 0.7 kW × 3 h

= 2.1 kWh

b) **STEP 5:** How much 2.1 kWh of energy costs.

STEP 6: Total cost = 2.1 kWh × 7.0¢/kWh

= 2.1 × 7.0 = 14.7

STEP 7: It cost 14.7¢ to run the cooling device for 3 h.

Find Out Activity (page 118)

LED Home Audit

Purpose

- Students conduct an LED Home Audit in which they identify uses for LEDs.

Science Background

LEDs are commonly used to indicate whether an electric device is on or off, but connected to a power supply. Even when they are off, electric devices that are plugged in are in "stand-by" mode, and thus use a small amount of power. LEDs indicating that a device is turned off also use a small amount of power.

To prevent leaving devices in stand-by mode, some devices, such as coffee makers, can simply be unplugged. Other devices, such as computer equipment, can be connected to a power bar, which can be switched on or off.

LEDs are also used in digital displays, such as on digital alarm clocks.

Lighting is a major household use of electric energy. As LED technology improves, white LEDs are becoming more widely used for lighting. LED lighting is extremely efficient and could substantially reduce power consumption and energy costs.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
1 day before	• Collect some examples of electric devices with LEDs.

APPARATUS	MATERIALS
• electric devices with LEDs	

Suggested Timing

5 min to introduce activity; 30–45 min to complete audit; 15 min to take up questions in class

Activity Planning Notes

Introduce the activity at the end of a class period. Show various examples of electric devices with LEDs. For example, point out the LED indicator light on a computer monitor.

Read the information together and make sure that everyone understands what to do. Have students complete the audit and answer questions 2 to 4 on page 119 at home.

Have students work in pairs to complete questions 5 and 6 on page 119 at the beginning of the next class.

Accommodations

- Provide students who are unable to complete the LED audit at home with **BLM 5–7 LED Home Audit**. They can use this to answer the questions on page 119.

What to Do Answers (page 119)

1. Answers will vary. Sample answers:

   Kitchen: coffee maker, microwave, oven

   Living room: air conditioner, CD player, DVD player, television, stereo

   Bedroom: alarm clock, computer, computer monitor, radio, LED lamp

   Bathroom: electric razor, hair dryer

   Other (e.g. hallway): answering machine, carbon monoxide detector, home security system

What Did You Find Out? Answers (page 119)

2. Answers will vary depending on which room contains the most electric devices.
3. LEDs are typically used as indicator lights on electric devices or in digital displays on clocks or other equipment. White LEDs can be used in reading lamps.
4. Most students will answer YES. Electric devices with LEDs that are on when the device is off but plugged in include: answering machines, carbon monoxide

detectors, home security systems, computers, DVD players, and televisions.

Making Connections Answers (page 119)

5. YES. Collectively and over time, many LEDs could use a relatively large amount of power.

6. Students may answer YES or NO.

YES. Explanations will vary. For example,

- It's a good idea if it is important to know that an electric device such as a carbon monoxide detector is functioning.

NO. Explanations will vary. For example:

- It isn't a good idea if an electric device, such as a DVD player, is turned on only at certain times and if it is easy to see whether or not the device is plugged in.

Activity Wrap-up

- Have students present their audit to the class. You or a class scribe could record the results on the chalkboard.
- As a class, discuss questions 2 through 6 on page 119.

Try This! Activity (page 119)

Purpose

- Students test and report the differences between a flashlight with a regular (incandescent) bulb and an LED flashlight.

Science Background

Incandescent bulbs produce diffuse light, making them effective for lighting entire rooms. LEDs tend to produce sharply focused light, making current LED technology more suitable for lighting limited areas, such as the inside of a car or a book. The use of LEDs in home lighting will likely become more common as the technology evolves.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 to 3 days before	• Obtain one or more regular pen flashlights and LED flashlights. • Obtain flashlight batteries. • Test the flashlights.
Day of	• Bring the flashlights to class.

APPARATUS	MATERIALS
• regular (incandescent bulb) flashlight (1 or more) • LED flashlight (1 or more)	

Suggested Timing

15 min

Safety Precaution

- Caution students not to move around the classroom when the lights are off.

Activity Planning Notes

You may wish to have students work in groups of four to complete this activity.
Provide student groups with flashlights. Have the students turn on their flashlights before you turn off the overhead lights. Students can pass the flashlights from group to group if the class is sharing.

Have students work in groups to complete the Try This! questions on page 119.

Accommodations

- Pair students with visual impairments with those who can describe the results.

Try This! Answers (page 119)

Students will likely find that the regular flashlight produces a brighter beam of light, but that the LED flashlight produces the beam of light that reaches the farthest. The regular flashlight produces a wider beam of light.

Activity Wrap-up

- Take up the answers to the questions in a class discussion. Ask students to explain why LEDs are not typically used to light large spaces in homes, schools, and other buildings.

Ongoing Assessment

- Use questions 2–6 on page 119 to assess students' participation and understanding of the Find Out activity.
- Use students' work in the Try This! activity on page 119 to assess their participation and the quality of their observations.

Technology Links

- For more information about white LEDs and their use in developing countries, go to **www.mcgrawhill.ca/books/Se10** and follow the links to LEDs Are Lighting Up the World.

Chapter 5 Review (page 120)

SUGGESTED TIMING

75 min to complete and take-up the review, and then assign the Practice Test

BLACKLINE MASTERS

Master 5 Certificate
Master 6 List of Skills
BLM 5–8 Chapter 5 Practice Test
BLM 5–9 Chapter 5 Test
BLM 5–10 BLM Answers

Accommodations

- Allow students who struggle with vocabulary and spelling to refer to the key word list or glossary in their Science Log as they complete the review activities.
- Have students create a formula sheet with the equations they need to use in calculating power rating and cost of energy used. They could refer to the sheet during review activities and the chapter test.
- 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 5–8 Chapter 5 Practice Test** can be customized to produce extra reinforcement questions.

Summative Assessment

- Have students complete **BLM 5–9 Chapter 5 Test** to assess individual skills.
- You may wish to develop **Master 5 Certificate** to show students what they have learned during this chapter. Cut and paste the related skills from **Master 6 List of Skills**.

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 with you before continuing. This process will prevent students from completing many questions incorrectly.

Once the review is completed and taken up, assign **BLM 5–8 Chapter 5 Practice Test** for students to answer individually. They may wish to use their completed review to help them.

Review Guide

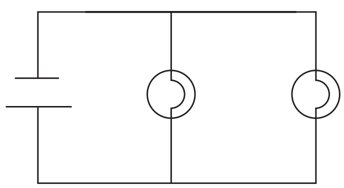
Question	Section(s)	Refer to
1	5.1	Measuring Current (page 106)
2	Chapter Opener	Electricity and You (page 102)
3	5.1	Measuring Voltage (page 107)
4 to 5	5.1	Understanding Electric Energy (page 103)
6	5.1	Potential Difference (page 108)
7 a)	5.1	The Flow of Electricity (page 104)
7 b)	5.1	Understanding Electric Energy (page 103)
7 c)	5.1	Measuring Current (page 106)
7 d)	5.1	Potential Difference (page 108)
8	5.1	Find Out: LED Wiring Challenge (page 109)
9	5.3	Find Out: LED Home Audit (page 118) and Try This! (page 119)
10	5.2	What Is Electricity Good For? (page 110) and Find Out: Energy Conversion Collage (page 111)
11	5.3	Science and Math Link: Calculate Your Cost (page 116)

Chapter 5 Review Answers (pages 120–121)

1. **e)** amperes
2. **f)** energy
3. **c)** volts
4. **a)** electric current
5. **d)** electric circuit
6. **b)** potential difference
7. **a)** F. If the loop is a completed electric circuit, it will allow electric current to flow.

   b) T

   c) T

   d) F. If the voltmeter is hooked up correctly, the voltage measured across a load in an electric circuit drops.
8. 
9. **a)** and **b)** Look for two differences between an LED and a regular light bulb.
   - An LED uses less electric energy than a comparable regular light bulb.
   - An LED does not get hot. A regular light bulb heats up while lit.
   - An LED produces a focussed light beam that does not spread outwards. A regular light bulb produces a wide beam of diffuse light.
   - The light from a white LED may look blue compared to the brighter, whiter light of a regular light bulb.
10. Answers will vary. Sample answers:

    a) Electric energy to heat; electric baseboard heater

    b) Electric energy to motion or movement; electric toothbrush

    c) Electric energy to sound; MP3 player

    d) Electric energy to heat; hair dryer
11. **a)** Energy used = *?*, Power = *4300 W* = 4.3 kW, Time = *0.5 h*

    Energy used = Power × Time = *4.3 kW × 0.5 h = 2.15 kWh*

    b) How much does *2.15* kWh of energy cost?

    Total cost = *9¢ × 2.15 kWh = 19.35¢*

    It would cost *19¢* to dry the jeans for *0.5 h.*