Activity Preparation for Chapter 7

Activity/Investigation	Advance Preparation	Time Required	Other Considerations
Try This! (page 141) (TR page 168)	• 2 to 3 days before – Obtain materials. – Construct a pinwheel to use for demonstration. • 1 day before – Photocopy **BLM 7–1 Pinwheel Template** and any assessment masters you decide to use. • Day of – Fill the kettle with water. – Set out materials.	• 20–30 min	• Steam can cause severe burns. You may wish to demonstrate how to use steam to turn the pinwheel instead of having students carry out this part of the activity on their own. • Remind students to be careful not to poke themselves with the pushpins.
What's Going On? Build an Electric Generator (page 142) (TR page 170)	• 2 to 3 days before – Collect quality magnets, strong paper tubes, ammeters that measure microamperes, and other materials. – Assemble materials and test equipment. – Photocopy **BLM 7–2 Build an Electric Generator**, **Master 1 Narrative Lab Report**, and any other blackline masters you decide to use. • Day of – Set out materials.	• 70 min	• Remind students to be careful not to scratch themselves with sharp wire ends. • Some students may need extra support to prepare the line graph. Consider using **BLM 3–7 Making a Line Graph**. • Consider allowing students to use a computer graphing program. Students might find **BLM 3–8 Making a Line Graph in Microsoft® Excel** helpful.
Find Out: What Turns Your Turbines? (page 148) (TR page 175)	• 1 week before – Book computer lab (optional). – Find out how electric energy is generated for the local community. • 1 day before – Photocopy **Master 3 Centimetre Grid Paper** and **Assessment Master 2 Co-operative Group Work Rubric**.	• 70 min	• Some students may need extra support to prepare the bar graph. Consider using **BLM 3–4 Making a Bar Graph**. • Consider allowing students to use a computer graphing program. Students might find **BLM 3–5 Making a Bar Graph in Microsoft® Excel** helpful.

Materials Needed for Chapter 7

Activity/Investigation	Apparatus	Materials	Blackline Masters
Try This! (page 141) (TR page 168)	• electric kettle (1 for class) • pitcher of water (1 per group) • sink or tub (enough for class to share)	Per group: • construction paper (1 sheet) • aluminum foil plate • drinking straw • pushpin • tape or glue • store-bought pinwheels (optional, 1 for demonstration and 1 per group)	**Recommended** BLM 7–1 Pinwheel Template
What's Going On? Build an Electric Generator (page 142) (TR page 170)	Per pair: • microampere ammeter • 2 alligator clips • weak bar magnet • strong bar magnet • working model electric generator or dynamo for a bicycle light (optional, 1 for teacher demonstration)	Per pair: • paper tube for packing coins • thick gauge wire (1 piece of each of 20 cm, 40 cm, and 60 cm)	**Recommended** BLM 7–2 Build an Electric Generator Master 1 Narrative Lab Report **Optional** Master 3 Centimetre Grid Paper BLM 3–7 Making a Line Graph BLM 3–8 Making a Line Graph in Microsoft® Excel Assessment Master 9 Using Tools and Equipment Checklist Assessment Master 10 Using Tools and Equipment Rubric Assessment Master 17 Narrative Lab Report Checklist
Find Out: What Turns Your Turbines? (page 148) (TR page 175)	• computers (optional, 1 per group)	• coloured pencils or markers (optional)	**Recommended** Master 3 Centimetre Grid Paper Assessment Master 2 Co-operative Group Work Rubric **Optional** BLM 3–4 Making a Bar Graph BLM 3–5 Making a Bar Graph in Microsoft® Excel

CHAPTER 7 Generating Electric Energy (page 140)

SUGGESTED TIMING	MATERIALS
15 min	• chart paper and markers

Overall Expectations

PEEV.01 – explain the generation, measurement, and conversion of electricity
PEEV.02 – investigate the factors that affect the generation and use of electricity
PEEV.03 – analyse the social, economic, and/or environmental implications of the sources and uses of electrical energy
SIMV.02 – investigate science-related information presented in print and electronic media using appropriate research and reporting skills
SIMV.03 – evaluate claims and presentations of science-related information in media

Science Background

Typically, power plants transfer electric current along transmission lines to transformers, which convert high-energy electricity into lower-energy electricity for residential use. Wires carry electric current from the transformer often found on a utility pole outside the home to a fuse box. From here, other wires carry electric current to outlets.

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 students keep a glossary at the back of their Science Log.
- Write a paragraph that contains the key terms in this section.

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

Activity Planning Notes

As a class, direct students to the cartoon on page 140 and discuss question 1. Have students use what they already know to brainstorm the pros and cons of wind energy and solar energy. You may wish to record their ideas on chart paper and have students make a list in their Science Log. At the end of the chapter, have students revisit the list and see how their ideas have changed.

Reading Icon Answer (page 140)

1. Students should circle: solar panel, wind turbine.

Check Your Understanding Answer (page 140)

2. Large communities need a large supply of electric energy, which only a power station can supply.

7.1 Electric Generators (page 141)

SUGGESTED TIMING

30 min
20–30 min for Try This!
70 min for What's Going On?

MATERIALS

- working electric generator or bicycle light dynamo or hand-crank flashlight

BLACKLINE MASTERS

Master 1 Narrative Lab Report
Master 3 Centimetre Grid Paper
BLM 3–7 Making a Line Graph
BLM 3–8 Making a Line Graph in Microsoft® Excel
BLM 7–1 Pinwheel Template
BLM 7–2 Build an Electric Generator
OHT B–9 How Do Electric Generators Work?
Assessment Master 9 Using Tools and Equipment Checklist
Assessment Master 10 Using Tools and Equipment Rubric
Assessment Master 17 Narrative Lab Report Checklist

Specific Expectations

PEE1.01 – describe different methods of generating electricity from other forms of energy
PEE1.03 – determine quantitatively and/or qualitatively the energy and power associated with electrical devices
PEE2.02 – design and build an electrical device, using lab equipment and materials safely
PEE2.03 – modify the electrical device they built to increase the amount of electrical energy it produces
PEE2.05 – communicate information using appropriate formats for specific purposes and audiences
SIM2.04 – organize and communicate information collected from lab investigations and information research using graphic organizers

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 students keep a glossary at the back of their Science Log.
- Create a concept map that shows the relationships among the key terms.

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

Reading Icon Answer (page 144)

13. The *turbine* moves a wire coil. The *wire coil* moves across a magnet. *Electric energy* flows in the wire coil.

Reading Icon Answer (page 145)

14. Students should highlight: hydroelectric power, wind power, burning fuel, and nuclear power.

Accommodations

- Pair ESL and LD Learners with students who have stronger language skills. Remind students to refer to their Science Log when they are confused about any key terms.
- Have students who have difficulty expressing themselves in writing discuss the answers to questions orally with a partner before recording the answers.

Activity Planning Notes

Introduce the section by bringing in a working electric generator. You can obtain one from a science supply store, or get a dynamo to power bicycle lights or a hand-crank flashlight from an electronics store. Demonstrate how the electric generator functions, or have students work in small groups to try out one or more types of electric generators. Make sure students recognize the key role of the rotating turbine in an electric generator.

Have students complete and then discuss question 3 followed by the Try This! activity on page 141.

Students will have a hands-on opportunity to learn about the role of a magnet in an electric generator by completing the What's Going On? activity on page 142.

Following the activity, as a class review the parts of an electric generator on page 144 using **OHT B–9 How Do Electric Generators Work**?

You may wish to have students work in small groups to read page 145 and answer the questions. Each group member could be responsible for summarizing one way of generating electric energy to the rest of the group.

Consider using the following overhead transparency:
- **OHT B–9 How Do Electric Generators Work?**

Check Your Understanding Answer (page 141)

3. Steam directed at a turbine pushes the blades of the turbine. As the turbine rotates, it generates electric energy.

Check Your Understanding Answers (page 145)

15. a)–c)

- water
- wind
- steam

Try This! Activity (page 141)

Purpose

- Students test different methods to turn a pinwheel using three sources of energy: steam, wind, and water.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 to 3 days before	• Obtain materials. • Construct a pinwheel to use for demonstration.
1 day before	• Photocopy **BLM 7–1 Pinwheel Template** and any assessment masters you decide to use.
Day of	• Fill the kettle with water. • Set out materials.

APPARATUS	MATERIALS
• electric kettle (1 for class) • pitcher of water (1 per group) • sink or tub (enough for class to share)	Per group: • construction paper (1 sheet) • aluminum foil plate • drinking straw • pushpin • tape or glue • store-bought pinwheels (optional, 1 for demonstration and 1 per group)

Suggested Timing

20–30 min

Safety Precautions

- Steam can cause severe burns. You may wish to demonstrate how to use steam to turn the pinwheel instead of having students carry out this part of the activity on their own.
- Remind students to be careful not to poke themselves with the pushpins.

Activity Planning Notes

The turbine in an electric generator works like a pinwheel. Students will test different methods to turn a pinwheel using three sources of energy: steam, wind, and water.

You can buy or build pinwheels for students or have them build their own using **BLM 7–1 Pinwheel Template**. Construction paper pinwheels work well with wind power. Pinwheels made from aluminum foil plates work well with water power or steam power.

For the first test, solicit students' suggestions as to how you can use a kettle of water to turn the pinwheel. Students should recognize that steam from the kettle would push on the pinwheel and turn it. In a class demonstration, boil water in the kettle and hold a pinwheel over the steam to turn the blades.

Have students work in small groups to come up with two other ways to turn their pinwheels. They should recognize that they could blow on the pinwheels to turn them (wind power) or pour water on the blades of the pinwheels (water power).

Be sure that students work over a sink or tub when working with water power.

You may wish to set up the activity as a design challenge. Students could compare the number of revolutions per minute of a pinwheel moving from water energy and wind energy, or compare the number of revolutions per minute of a paper pinwheel and a foil pinwheel. Students should use a table to record their observations of revolutions per minute.

Accommodations

- Students with attention difficulties may go off task. You might supervise such students more closely, and/or chunk the activity.
- Pair students with dexterity problems with those without such difficulties.
- Less confident learners may be hesitant to contribute ideas to the group. Consider setting up a class protocol about getting ideas from all group members before carrying out procedures or moving on to the next step.

Activity Wrap-up

- Have groups share their results in a class discussion. If you used the activity as a design challenge, have each group present their pinwheel designs.
- Ask students what their pinwheels have in common with the turbines in electric generators. Students should recognize that steam, wind, or water can be used to turn the blades of a turbine in an electric generator.

What's Going On? Activity (page 142)

Build an Electric Generator

Purpose

- Students build an electric generator.
- Students manipulate variables and measure electric energy output.

Science Background

An electric generator has three basic components: a coil of wire that conducts electricity, a magnet to produce a magnetic field, and a power source to turn the coil of wire in the magnetic field or move the magnet across the wire. When the magnetic field of the magnet interacts with the wires, it causes electrons to move within the wire. The flow of electrons provides a steady flow of electricity.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 to 3 days before	• Collect quality magnets, strong paper tubes, ammeters that measure microamperes, and other materials. • Assemble materials and test equipment. • Photocopy **BLM 7–2 Build an Electric Generator**, **Master 1 Narrative Lab Report**, and any other blackline masters you decide to use.
Day of	• Set out materials.

APPARATUS	MATERIALS
Per pair: • microampere ammeter • 2 alligator clips • 1 weak bar magnet • 1 strong bar magnet • working model electric generator or dynamo for a bicycle light (optional, 1 for teacher demonstration)	Per pair: • paper tube for packing coins • thick gauge wire (one piece of each of 20 cm, 40 cm, and 60 cm)

Suggested Timing

70 min

Safety Precautions

- Remind students to be careful not to scratch themselves with sharp wire ends.
- Remind students to clean up the work area and put away all equipment after the activity.

Activity Planning Notes

Explain to students that they will build an electric generator. They will manipulate some features of their generators and measure the electric current produced as a result of each change.

Explain that a generator uses a coil of wire, a magnet to create a magnetic field, and a force to move the coil of wire or the magnet itself to produce an electric current. You may wish to use a working model electric generator or dynamo for a bicycle light to demonstrate this concept.

As a class, read the directions on page 142 and encourage discussion until everyone understands what to do. Demonstrate how to handle the materials and use the ammeter. Remind students to set the ammeters to microamperes, if necessary. Students should work in pairs so that one student can move the magnet while the other student reads the ammeter.

Consider using **Assessment Master 9 Using Tools and Equipment Checklist**, if needed, to reinforce the importance of using equipment and materials properly.

Have students predict how manipulating the generator design will affect the amount of current produced by posing the following prompts:

- Will the strength of a magnet affect the amount of current produced? If so, which magnet will result in a stronger current?
- Will the number of coils in a wire affect the amount of current produced? If so, how?

Have students answer these questions using **BLM 7–2 Build an Electric Generator**.

You may wish to review making a line graph using **BLM 3–7 Making a Line Graph**. Consider allowing students to use a computer graphing program. If so, students might find **BLM 3–8 Making a Line Graph in Microsoft® Excel** useful.

Accommodations

- Some students may need additional reinforcement to process the information and the instructions. Alternatively, such students could be paired with students who have stronger skills.
- Pair students with dexterity problems with those without such difficulties.
- Provide support to students who have difficulty making the graph. Remind students to use a different colour for each magnet.
- Provide students who need more space to record their graph with **Master 3 Centimetre Grid Paper**.

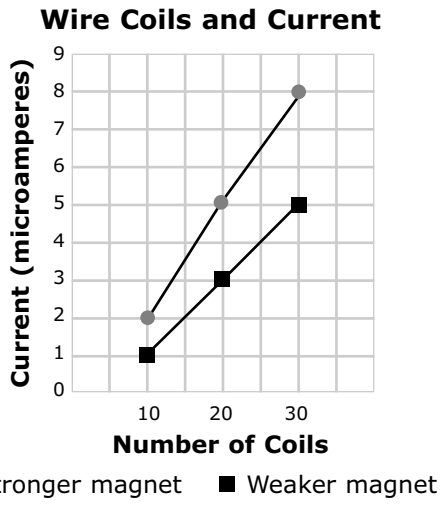
What's Going On? Activity Answers (pages 143–144)

6. Results will vary depending on the strength and quality of the magnets and the quality of the gauge wire used. The stronger magnet should result in a greater current than the weaker magnet. Also, the more coils of wire used, the greater the electric current produced.

Sample results:

Coils of Wire	Current (microamperes)	
	Weaker Magnet	Stronger Magnet
10	1	2
20	3	5
30	5	8

7. Values will vary, but the results should be consistent with the trends shown in the sample graph. The graph should be titled and labelled, and have a key. For example:



8. The more coils in the wire, the greater the electric current produced.

9. The stronger magnet produced a greater electric current than the weaker magnet.

10. Student muscles supplied the force that moved the magnet.

11. The pinwheel could be attached to a magnet. Air would turn the pinwheel, which would move the magnet around or along a wire coil to generate electric energy. Alternatively, the pinwheel could be attached to a wire coil wrapped around a magnet. As the pinwheel turned, it would move the wire coil around the magnet to generate electric energy.

12. Look for one of the following ways:

- increase the number of coils in the wire
- use a stronger magnet
- increase the speed at which the wire coil or magnet moves

Activity Wrap-up

- Have students complete questions 7 to 12 on pages 143 and 144 in the student resource.
- Have students share their results with other pairs, and then in a class discussion.
- Consider having students write a report using **Master 1 Narrative Lab Report**. If so, distribute **Assessment Master 17 Narrative Lab Report Checklist** and review the criteria for the narrative lab report.

Ongoing Assessment

- Use question 3 on page 141 to assess students' understanding of how turbines work in an electric generator.
- Assess students' use of tools and equipment using **Assessment Master 10 Using Tools and Equipment Rubric**.
- Use the narrative lab reports for the What's Going On? activity to assess students' learning during the activity.
- Use questions 14 and 15 on page 145 to assess students' understanding of sources of power used to generate electric energy.

Technology Links

- For an interactive activity in which students manipulate an electric generator, go to **www.mcgrawhill.ca/books/Se10** and follow the links to How an Electric Generator Works.
- For information and interactive activities about electricity, go to **www.mcgrawhill.ca/books/Se10** and follow the links to World of Wires.

Alternative Activities

- Obtain an electric device, such as a light that is powered with a hand crank. Have students try different methods to vary the amount of light produced. For instance, students could find out how the number of revolutions or speed of revolutions affects the amount of light produced. Have students graph the results.
- Challenge students about electric energy generation with questions such as:
  – How are magnets and wire coils arranged in electric generators?
  – Where does the energy come from to move the magnet or wire coil in an electric generator?

  Have students conduct research on the Internet or library to answer the questions and then present their findings.

7.2 Technologies for Generating Electric Energy (page 146)

SUGGESTED TIMING

30 min
70 min for Find Out

BLACKLINE MASTERS

Master 3 Centimetre Grid Paper
BLM 3–4 Making a Bar Graph
BLM 3–5 Making a Bar Graph in Microsoft® Excel
Assessment Master 2 Co-operative Group Work Rubric

Specific Expectations

PEE1.01 – describe different methods of generating electricity from other forms of energy
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
PEE3.01 – compare technologies used for generating electrical energy, including their social, economic, or environmental implications
SIM2.04 – organize and communicate information collected from lab investigations and information research using graphic organizers

Science Background

Most forms of renewable energy ultimately come from the Sun. Energy from the Sun heats the ground, which re-radiates heat at the surface of Earth. The Sun also drives Earth's water cycle: energy from the Sun heats air and water, which results in cloud formation and produces winds and ocean currents.

Except for a few deep-ocean dwelling species, most forms of life depend on energy from the Sun. Through photosynthesis, plants capture the energy in sunlight and use carbon dioxide from the atmosphere to make plant sugars. Plant sugars not only sustain plants, but sustain animals that feed on plants, and, indirectly, animals that feed on other animals.

Under the right conditions, decomposer organisms break down organic matter from dead plants and animals and their wastes. In different environmental conditions, the organic matter persists. Over millions of years, the build up of organic matter resulted in rich deposits of fossil fuels. Since it takes such a long time for fossil fuels to form, they are considered a type of non-renewable 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 these terms in their Science Log. You may wish to have students keep a glossary at the back of their Science Log.
- Create a Venn diagram that shows what fossil fuels and solar power share in common and how they are different.

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

Reading Icon Answer (page 146)

1. Students should circle any four of: the ground, clouds, wind, plants, or solar panels on a home.

Reading Icon Answers (page 147)

2. a) and **b)**

- fossil fuels
- nuclear power

Accommodations

- Pair ESL and LD Learners with students who have stronger language skills. Remind students to refer to their Science Log when they are confused about the key terms.
- Have students who have difficulty writing discuss the answers orally.

Activity Planning Notes

Have students study the cartoon on page 146. Discuss the role of the Sun in climate and weather, and as the ultimate source of food energy for organisms including people.

Have students work in pairs to complete the questions on renewable energy and non-renewable energy on pages 146 and 147. Take up the answers in a class discussion before moving on to the Find Out activity on page 148.

Check Your Understanding Answers (page 147)

3. a)–c)

- sunlight
- wind
- hydroelectric power (water)

4. A fossil fuel is made from the remains of plants and animals that have been compressed over millions of years.

5. a)–c)

- coal
- oil
- natural gas

6. Sample answer: There is a limited amount of uranium in Earth's crust and it cannot be replaced after it is used up.

7. Sample answer: Hydroelectric power comes from flowing water. Rivers should continue to flow as long as water circulates through the water cycle.

Making Connections Answer (page 149)

5. Ontario has more water than Alberta and has no fossil fuel deposits, while Alberta has extensive fossil fuel deposits.

Find Out Activity (page 148)

What Turns Your Turbines?

Purpose

- Students research and report on electric energy generating technologies used in Canada and Ontario.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
1 week before	• Book computer lab (optional). • Find out how electric energy is generated for the local community.
1 day before	• Photocopy **Master 3 Centimetre Grid Paper** and **Assessment Master 2 Co-operative Group Work Rubric**.

APPARATUS	MATERIALS
• computers (optional 1 per group)	• coloured pencils or markers (optional)

Suggested Timing

70 min

Activity Planning Notes

Introduce the activity as an opportunity for students to compare how electric energy is generated in their own community with how it is generated across Ontario and Canada as a whole.

Consider having students work in small groups. Remind them that each student is expected to produce a copy of the results and answer the questions.

As a class, read the information on page 148. Before students begin their graphs, you may wish to review making a bar graph using **BLM 3–4 Making a Bar Graph.** Consider allowing students to use a computer graphing program. If so, students might find **BLM 3–5 Making a Bar Graph in Microsoft® Excel** useful.

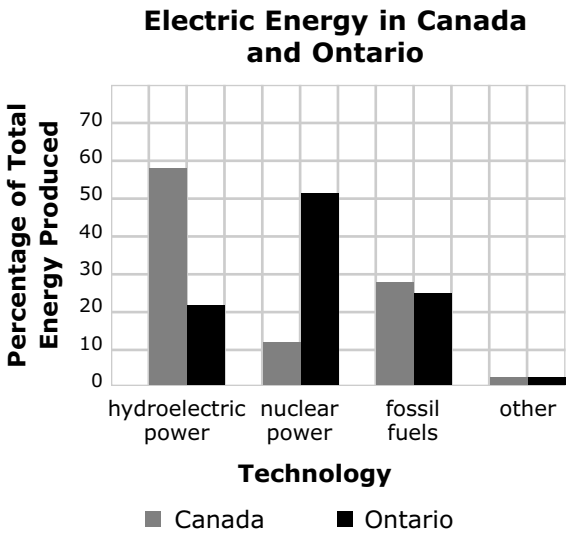
You might have groups use **Master 3 Centimetre Grid Paper** and create an enlarged version of their bar graph to help present the findings.

Accommodations

- Have students with dexterity problems work with someone who can help them draw the graph.
- Provide students who need more space to record their graph with **Master 3 Centimetre Grid Paper**.

Find Out Activity Answers (pages 148–149)

1. The graph should be titled and labelled, and have a key. For example:



3. a) hydroelectric power

b) nuclear power

4. Answers will vary depending on the community in which your school is located. Sample answers for Sault Ste. Marie:

a) hydroelectric power and wind power

b) Yes. Sault Ste. Marie is unusual because it gets electric energy from the Gros Cap Heights Wind Farm, which is the largest electric energy generating wind farm in Ontario.

c) Yes and No. The use of wind power makes Sault Ste. Marie unusual in Ontario, but like much of the province, the community also depends on hydroelectric power.

Activity Wrap-up

- Have students work in groups to answer the questions on page 149. You may wish to provide in-class time for students to research local electric energy generation.
- Have student groups present their graphs in an oral presentation. Ask students which graphs effectively illustrate the data and explain why. Students should note the graphs that were easiest to read and interpret. Discuss the value of using bar graphs to compare data.
- Have students share answers to questions 3 and 4 on page 149.
- Have students complete and then discuss question 5 on page 149.

Ongoing Assessment

- Use the questions on page 147 to assess students' understanding of renewable energy and non-renewable energy.
- Assess the bar graphs students completed for the Find Out activity.
- Consider assessing students' ability to work co-operatively during the Find Out activity using **Assessment Master 2 Co-operative Group Work Rubric**.

Technology Links

- For information and visuals about renewable energy sources such as solar, wind, water and biomass, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Renewable Energy. The site also features information about building working models of each energy source.
- For a map that shows the 815 generating stations in Canada with a capacity of 500 kilowatts or greater organized by energy source, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Map.

Alternative Activity

- As an extension of the Find Out activity, have students research one of the following technologies used in Canada: hydroelectric power, nuclear power, fossil fuels, wind power, or an alternative technology. Have students answer questions such as:
  – Who uses hydroelectric power?
  – What is hydroelectric power?
  – Where are hydroelectric dams found?
  Have students present their findings in a format of their choice (e.g., news report, poster).

7.3 What's the Best Way to Generate Electric Energy? (page 150)

SUGGESTED TIMING

140 min

BLACKLINE MASTERS

Master 2 Writing an Opinion Paragraph
OHT B–10 Electric Energy and the Environment
Assessment Master 6 Scientific Communication Rubric

Specific Expectations

PEE1.01 – describe different methods of generating electricity from other forms of energy
PEE2.01 – locate and select information from various sources to identify factors affecting generation and use of electricity
PEE3.01 – compare technologies used for generating electrical energy, including their social, economic, or environmental implications
SIM2.03 – interpret research data, including analysis for accuracy and bias as appropriate, using a range of strategies for reading for information
SIM2.04 – organize and communicate information collected from lab investigations and information research using graphic organizers

Science Background

People have been using renewable forms of energy for centuries. Traditionally, windmills and watermills powered simple machinery. People are revisiting these technologies as alternative means of generating electric energy since they have less impact on the environment than burning fossil fuels.

The increase in carbon dioxide in Earth's atmosphere since the Industrial Revolution is largely a result of fossil fuel use. Carbon dioxide and other greenhouse gases trap heat in the atmosphere, warming Earth. Many scientists agree that the increase of greenhouse gases in the atmosphere results in global warming.

The alternatives to using fossil fuels have pluses and minuses. Hydroelectric power is renewable and does not produce polluting emissions but it can have an impact on the environment. Nuclear power does not produce air pollution but used nuclear fuel is radioactive and therefore dangerous. The 1986 explosion of the Chernobyl nuclear reactor contaminated a large region of Eastern Europe, which remains contaminated today.

Alternative energy sources may have unintended environmental and health impacts. For example, some solar panels are made out of toxic materials, and depending on how geothermal energy is used, the process can release hydrogen sulfide gas or toxic sludge.

Biomass energy is gaining importance as a way to turn waste into energy. Mushrooms and various micro-organisms obtain energy by breaking down dead plant and animal matter. The process of decomposition produces gases such as methane. The methane can be burned cleanly for energy.

Key Terms Teaching Strategies

Have students complete the following activity to help them learn and remember the key terms:

- Write definitions for these terms in their Science Log. You may wish to have students keep a glossary at the back of their Science Log.

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

Reading Icon Answer (page 150)

1. Students should circle advantages and underline disadvantages of each technology.

- Fossil fuels

  Advantages: fossil fuels are plentiful; have the technology to easily obtain them; burn them as needed to create steam..

  Disadvantages: they are non-renewable; burning fossil fuels, such as coal and oil produces air pollution; harms the health of people and natural environments; also releases greenhouse gases; greenhouse gas around Earth could be changing the climate

- Hydroelectric power

  Advantages: it is a renewable energy; does not produce pollution or harmful waste products

  Disadvantages: dams change the flow of rivers and flood large areas of land; can harm plants and animals

- Nuclear power

  Advantages: small amount of uranium is needed to produce a large amount of nuclear power; do not produce air pollution or greenhouse gases

  Disadvantage: creates dangerous nuclear waste that cannot be broken down

Reading Icon Answer (page 152)

1. Students should highlight:

- solar power: convert light directly into electric energy
- wind power: wind to turn the turbines
- natural gas from waste: trap natural gas for energy and burn it to power electric generators
- geothermal: heat from under Earth's surface used to produce steam for electric generators

Reading Icon Answer (page 154)

1. Answers may vary. Students should highlight information about the pros and cons of each technology. Sample answer:

- Coal

  Pros: lots of coal; it's cheap; it's reliable; can store it and use it when we need to; doesn't depend on the weather like solar power and wind power

  Cons: non-renewable; burning coal produces smog and greenhouse gases; smog costs $9.6 billion a year in health-care costs and environmental damage

- Hydroelectricity

  Pros: small hydroelectric power station uses the natural flow of a river; cheap to operate once they are up and running

Cons: running out of places to build power stations; expensive to build; hydroelectric power won't be enough

- Nuclear

  Pros: need a reliable power source; can't afford blackouts

  Cons: nuclear waste is just too dangerous; many sources of renewable energy we could use instead

Activity Planning Notes

As a class, have volunteers read the Science and Literacy Link on page 150 aloud. Have students answer and then discuss question 1.

Have students work in small groups to complete the PMI chart on page 151. Afterward, use **OHT B–10 Electric Energy and the Environment** to complete a chart using input from the class. Each group could contribute answers for part of the chart.

Foster interest in alternative energies by asking students to visualize a science fiction future of Earth where fossil fuels, nuclear power, and hydroelectric power are not available. Ask students to suggest what the world might look like and how people would generate electric energy. Alternatively, you may wish to show a video about an alternative energy.

Have students read pages 152 and 153 about alternative energies and then work in small groups to complete the PMI chart on page 153. Follow up with a class discussion. Consider using an overhead transparency copy of the PMI chart to complete a chart using input from each group.

Read the Science and Media Link on page 154 together. Have volunteers take on roles and read the blog entries.

Students can work individually or in pairs to complete question 2 on page 155. Let students know how you plan to assess their work. Remind students that although they are encouraged to discuss ideas with each other, they should produce their own written work.

Consider using the following overhead transparency:
- **OHT B–10 Electric Energy and the Environment**

Accommodations

- Pair ESL and LD learners with reading partners. Have partners take turns reading the information and then discuss their answers to the Reading Icon questions on pages 150 and 152.
- Have students who need support to categorize renewable and non-renewable sources of energy use an organizer.
- Provide students who need more space to complete the PMI chart on page 151 with a copy of **OHT B–10 Electric Energy and the Environment**. If students need more space to complete the PMI chart on page 153, have them use a separate sheet of paper.
- Provide students who need more space to complete the opinion paragraph on page 155 with **Master 2 Writing an Opinion Paragraph**.
- Allow students to present their opinion for the Science and Media Link on page 154 in an oral report.

Check Your Understanding Answers (page 151)

2. Answers for the Interesting column may vary. Sample answers:

Fossil fuels

- Plus: plentiful at present; easily obtainable; burning fossil fuels to create steam is a relatively simple process
- Minus: non-renewable; burning produces unhealthy pollution and greenhouse gases
- Interesting: Canada has a large supply

Hydroelectric power

- Plus: renewable; relatively simple process; does not produce pollution or harmful waste products
- Minus: dams change the flow of rivers and flood large areas, which can harm plants and animals
- Interesting: Ontario has many rivers that can provide hydroelectric power

Nuclear power

- Plus: only small amounts of uranium needed; does not produce harmful air pollution or greenhouse gases
- Minus: uranium is non-renewable; uranium creates dangerous nuclear waste
- Interesting: Ontario relies heavily on nuclear power

Check Your Understanding Answers (page 153)

2. Answers for the Interesting column may vary. Answers may vary depending on the community where students live. Sample answers:

Solar power

- Plus: renewable; nonpolluting; quiet; useful in remote areas
- Minus: panels not very efficient; solar power can be used only when there is sunlight
- Interesting: solar farms more efficient than solar panels

Wind power

- Plus: renewable; nonpolluting
- Minus: generates energy only when the wind blows; birds killed in turbine blades
- Interesting: energy can be stored in a battery; some locations in Canada windy enough to supply wind-generated energy to large areas

Natural gas from waste

- Plus: garbage and animal waste converted into renewable energy; natural gas is clean-burning
- Minus: burning natural gas produces greenhouse gas
- Interesting: farmers could sell manure as an energy source

Geothermal energy

- Plus: renewable; nonpolluting
- Minus: not possible to access geothermal energy from all locations
- Interesting: Earth's interior is more than hot enough to boil water

Science and Media Link Answers (page 155)

2. a) Opinions will vary. Look for at least three fact-based supporting points. Sample answer:

Opinion: Ontario should focus on using renewable energy, particularly hydroelectric power, solar power, and wind power.

Supporting Points:

- These methods do not produce harmful pollution or greenhouse gases.
- Wind power can be used across Ontario.
- Relying on a combination of methods will better ensure a supply of electric energy than relying on a single source.

b) Paragraphs will vary. Students should use the sentence stems to express an opinion and provide supporting points. Sample answer:

I think that renewable energy sources such as hydroelectric power, wind power, and solar power are the best ways to generate electric energy.

I think this way because polluting the environment should not be an option. Hydroelectric power, wind power, and solar power do not produce harmful pollution or greenhouse gases. Additionally, we should focus on renewable energy because non-renewable sources of energy such as coal and oil will run out in the future.

Other people think that Ontario should continue to use nuclear power because it can produce a lot of energy, and cheap fossil fuels because they are convenient. Some people think that there are not enough big rivers to use hydroelectric power.

I don't agree because I worry about the environment. It is too difficult to dispose of nuclear waste, and if we continue to pollute the air and water by burning fossil fuels, all living things will suffer.

Alternative Activities

- Show a video called *Poop Power*, outlining the operation of an anaerobic digester (Town and Country Ontario, Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA), 2004). See the Technology Links.
- Have students work in groups to research and create a wall chart about renewable and non-renewable energy sources used to generate electric energy. The wall chart should include a definition of renewable and non-renewable energy and provide three examples of each category. Have students list at least two advantages and disadvantages for each example, and provide an image.
- Have interested students conduct Internet or library research about the electric energy generation method they supported on page 155.
  – What are some further advantages or disadvantages of the method?
  – What are the latest improvements to the technology and why were they made?
  Students can record their findings in their Science Log or another format of their choice.
- Have students submit their opinion paragraph to the Ministry of Energy as feedback to the 2006 report called "Our Energy, Our Future." Review students' work before they submit it.
- Use some or all of the activities in the following Physics *ActiveFolders*: Energy.

Ongoing Assessment

- Use the answers to question 2 on page 151 to assess students' comprehension of the impact of different methods of generating electricity on the environment.
- Use the answers to question 2 on page 153 to assess students' ability to identify pluses and minuses of sources of electric energy for their own community.
- Consider assessing the opinion paragraphs that students wrote on page 155 by adapting **Assessment Master 6 Scientific Communication Rubric**.

Technology Links

- For information on wind power generation in Canada and Ontario, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Wind Power Generation.
- For information about electricity and natural gas, go to **www.mcgrawhill.ca/books/Se10** and follow the links to About Electricity and Natural Gas.
- For a video about natural gas production from manure, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Poop Power.
- For information about the environmental impact of renewable energy provided by the Union of Concerned Scientists, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Clean Energy.
- The Provincial Government of Ontario solicited public opinion on the 2006 report, "Our Energy, Our Future." To link to the report and online feedback, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Ontario's Energy Future.

Chapter 7 Review (page 156)

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 7–3 Chapter 7 Practice Test
BLM 7–4 Chapter 7 Test
BLM 7–5 BLM Answers

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 7–3 Chapter 7 Practice Test** can be customized to produce extra reinforcement questions.

Summative Assessment

- Have students complete **BLM 7–4 Chapter 7 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 before continuing. This process will prevent students from completing many questions incorrectly.

To provide additional reinforcement of key terms, have students create concept maps comparing renewable and non-renewable forms of energy. Once the review is completed and taken up, assign **BLM 7–3 Chapter 7 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	7.1	Electric Generators (page 141)
2	7.2	Renewable Energy (page 146)
3	Chapter Opener	Chapter Opener (page 140)
4	7.1	Electric Generators (page 141)
5 to 6	7.2	Non-renewable Energy (page 147)
7 to 8	7.1	How Do Electric Generators Work? (pages 144 to 145)
9	7.3	Geothermal Energy (page 153)
10 to 11	7.1	How Do Electric Generators Work? (pages 144 to 145)
12	7.3	Science and Literacy Link (page 150)
13	7.2	Find Out Activity (page 148)
14	7.3	Wind Power (page 152)
15	7.2 7.3	Renewable Energy (page 146) Non-renewable Energy (page 147) What's the Alternative? (pages 152 to 153)

Chapter 7 Review Answers (pages 156–157)

1. d) electric generator

2. e) renewable

3. j) power stations

4. h) turbine

5. f) non-renewable

6. a) fossil fuels

7. c) nuclear power

8. b) hydroelectric power

9. g) geothermal

10. a) turbine

b) shaft

c) wire coil

d) magnet

11. Answers will vary depending on method. Methods include using nuclear power, geothermal energy, solar power, burning fossil fuels to heat water, falling water or wind. Sample answer:

- Wind pushes on the blades of a turbine. As the turbine rotates, it generates electric energy.

12. a) fossil fuels

b) Extra greenhouse gases around Earth could affect the climate by trapping heat close to Earth.

13. a)–c)

- hydroelectric power
- nuclear power
- fossil fuels

14. Look for one of the following advantages and disadvantages:

Advantages:

- does not produce pollution
- renewable
- free

Disadvantages:

- generates electric energy only when the wind is blowing
- birds sometimes fly into wind turbines and get killed

15. a) hydroelectric power: renewable

b) coal: non-renewable

c) nuclear power: non-renewable

d) wind power: renewable

e) geothermal energy: renewable

f) sunlight: renewable

g) natural gas: renewable and non-renewable

h) Natural gas that formed as a fossil fuel is non-renewable. Natural gas derived from rotting garbage or manure is renewable.