Unit 4 The Characteristics of Electricity

Unit 4 Electrical Applications

BIG IDEAS

- Electricity is a form of energy produced from a variety of non-renewable and renewable sources.
- The production and consumption of electrical energy has social, economic, and environmental implications.
- Static and current electricity have distinct properties that determine how they are used.

Overall Expectations

- **E1** assess the major social, economic, and environmental costs and benefits of using electrical energy, distinguishing between renewable and non-renewable sources, and propose a plan of action to reduce energy costs
- **E2** investigate, through inquiry, the properties of static and current electricity and the cost of the consumption of electrical energy
- **E3** demonstrate an understanding of the concepts and principles of static and current electricity

Materials

Please see page TR-48 for a list of the materials required for this unit.

Overview

In this unit, students will learn how electricity can be produced from non-renewable and renewable sources, investigate the properties of static and current electricity, and explore the social, economic, and environmental implications associated with the production and consumption of electrical energy. In Topic 4.1, students learn how electricity is generated from different resources, and compare the advantages and disadvantages of using renewable versus non-renewable sources of energy. In Topic 4.2, students investigate how charges behave with each other, and distinguish between conductors and insulators. In Topic 4.3, students use an electroscope to explore different ways of charging and discharging objects. In Topic 4.4, students learn how charges can be controlled and used in electric circuits. In Topic 4.5, students study the properties of series and parallel circuits. In Topic 4.6, students learn about different features that make home circuits safe. In Topic 4.7, students learn how electrical energy is measured, and consider how energy can be conserved by becoming informed consumers.

Using the Unit Opener

- The photo in the unit opener features the Sun setting over the horizon in a serene marshland area. Use this photo as a starting point to discuss the power of the Sun. Have students brainstorm a list of ways that the Sun's energy is transformed for use in our daily lives, for example, light and warmth; photosynthesis; and solar-powered devices.
- The three Big Ideas of this unit are presented on page 238. Have students divide one sheet of paper into three columns and write one Big Idea at the top of each column. Have students write anything they already know about the topics conveyed in the Big Idea. As an option, encourage English language learners to sketch pictures to express what they know. You can use this table to assess students' prior knowledge of and misconceptions about electricity, so you will have the opportunity to differentiate the instruction based on each student's need. Alternatively, refer students to the Literacy Toolkit and have them choose another graphic organizer to complete this activity (e.g., spider web).
- ELL You may need to simplify the language in the Big Ideas for English language learners. Read aloud the first idea, and model how to simplify the idea. For example, Electricity is a type of power that comes from, or is made from, different places or things. Electricity can be made from renewable things. These are things that do not go away, such as the wind or the Sun. Electricity can also be made from non-renewable things. These are things that can only be used once. When you have used them, they are gone forever. English language learners can copy this simplified statement at the top of the first column. Ask the class to help simplify the language in the next two big ideas.
- Distribute **BLM 4-1 Electricity Anticipation Guide**, for students to complete. Have them compare their answers with a classmate's. After you have completed the unit, students can fill out the anticipation guide again, and consider how and why their answers might have changed. Encourage the use of prompts to promote critical thinking. "Have your answers changed? Highlight what is different about your answers. Why do you think your answers changed? What did you learn that changed your answers?"

- Read aloud the lyrics of the song "Electricity," by Orchestral Manoeuvres in the Dark, on page 239, or play a recording of the song, while students follow along. Have students work in pairs or small groups to discuss the message in the song. Suggest students copy the lyrics into their notes and use underlining and point-form notes in the margins to emphasize the different parts of the song. For example, they can underline the different sources of energy (nuclear, carbon fuels, solar), or circle "HEP" and brainstorm or research what it may stand for.
  - ELL Place English language learners with students who have strong English language skills. This will allow them to "listen in" on the discussion and be guided to complete the activity.
- Enrichment—Have students write a third verse to expand on the concept of "solar electricity". Alternatively, have students research and find other songs that inform listeners about electrical energy (e.g., "Electricity" and "The Energy Blues" from Disney's "Schoolhouse Rock!" video series). You can use these songs to introduce new concepts and/or review material at the end of the unit.
  - DI Musical learners may be willing to perform their verse for the class.
- Explore the question in the inset on page 239, "What challenges must be overcome for the Sun to be a practical source of electrical energy?" Students will likely be familiar with different solar-powered devices such as calculators, solar-panelled homes, and even cars. But, do they know how the Sun's energy is used to generate electrical energy? Discuss the possible problems or challenges associated with harnessing the Sun's energy from social, technical, economical, and environmental points of views.
- ELL To support English language learners, have available real objects that are solar-powered such as calculators and pictures of other items such as cars and solar-panelled homes. Relate the questions you ask directly to the real object. "How does this calculator work? How does this car work? How can we use to the Sun in more ways? How and why is this difficult to do?"

Preparing for the Unit Projects

Read pages 328–329 to introduce students to the Projects in this unit. The Inquiry Investigation involves planning a way to reduce energy consumption in a room in the students' homes. Students will need to understand concepts of power consumption (Topic 4.7), research how different devices help to reduce energy consumption (Topics 4.6 and 4.7), and be able to draw circuit diagrams (Topic 4.4). Some students may prefer to carry out these Projects in the school, rather than in their own home. Allow students to do this if they wish, and provide any materials they may need.

An Issue to Analyze challenges students to find out which power companies in Ontario use "greener" energy sources. Students will need to understand the differences between renewable and non-renewable energy sources (Topic 4.1), and conduct research on different power companies such as the one in Investigation 4A.

Have students choose which project they would like to complete. Students who prefer more hands on, less theoretical, activities will probably be more comfortable with the Inquiry Investigation. Once they have made a choice, have them scan the unit, and identify topics that may provide them with information they need to complete the project. As you work through the unit, draw students' attention to skills or concepts that will be useful to them.

ELL English language learners will definitely find the Inquiry Investigation less linguistically demanding. It is essential to group these students and provide step-by-step guidance. Provide them with a template as a guideline for this investigation. In addition you may wish to provide websites and/or print resources that include strong visual supports.

Get Ready

Students will design a test to carry out.
Students will analyze diagrams.
Students will interpret data from a table.
Students will communicate in writing.

Students can review some of these skills using **BLM 4-2 Skills for Unit 4**.

- ELL The Get Ready section is an outline of what skills students need for the Unit. It also helps you to determine students' prior knowledge. English language learners may have the necessary skills and knowledge in their first language but not in English. To help them, pre-teach some of the vocabulary: current, series, transformed, parallel, static, charge, circuit, flow, insulator, conductor. There are several ways to do this.
- Print these key words on the board and attach icons or drawings to support meaning. English language learners can start an Electricity Glossary with words, pictures, and simple definitions.
- English language learners may partner up to play simple games to reinforce this vocabulary. For example, they can write words on one set of blank cards and definitions on another set. Students match words and definitions while playing a game such as Tic-Tac-Toe, Stickman, or Memory.
  - ELL When English language learners are missing these beginning electricity concepts, you may be teaching the concepts and language concurrently. In this case you should work through the questions on pages 242 and 243 together in a small group, providing language support to rephrase questions, define vocabulary, and guide written responses. In the Inquiry Check (question 4), model and provide a format of how to design a test.

Get Ready Answers

1. a) transformed **b)** static **c)** current **d)** series **e)** parallel

2. For example:

Insulating Materials	Conducting Materials
paper placemats	laptop computer
paper plates	music player
plastic cutlery	chair legs
glasses	wheel spokes
plastic chairs	earrings
wooden tables	belt
plastic storage containers	filament in light bulb on wall
plastic chip bag	
sandwich cling wrap	
clothing and shoes	
book	
rubber wheel	
food	
water	

3. a) sound energy **c)** sound energy, light energy
b) light energy, heat **d)** mechanical energy, sound energy

4. Answers will vary, but could include rubbing balloon on sleeve and trying to stick it to the wall.

5. a) Circuit B **b)** Circuit A **c)** Circuit A **d)** Circuit B

6. a) Summer weekdays from 11 A.M.–5 P.M.; Winter weekdays from 7 A.M.–11 A.M. and 5 P.M.–8 P.M.
b) Weekends and holidays (all day)

7. Answers will vary. For example, "Good morning, Teachers, Staff, and Students! During this heat wave, it's tempting to be cool by using lots of air conditioning. But it you really want to be cool, don't jack up the conditioning too much. Remember, the electricity that powers the air conditioning costs you money. And if everybody uses too much, we might have another power outage. Plus, the less electricity we can use, the better it is for the environment. Be cool. Reduce your daily electricity use wherever you can. It's good for all of us."

Assessment OF Learning for Unit 4

Activity	Evidence of Learning	Supporting Learners
Unit Inquiry Investigation, page 328	Students accurately draw two circuit diagrams–one representing the room as it is and the other including dimmer switches and power bars.	• Gather a few household electric devices (such as light bulb, hair dryer, electric kettle) to show students where the power rating can be found (usually on a label/tag or stamp on the back of the device).
	Students analyze the impact of the changes they recommend on energy consumption.	• Give students a copy of **BLM 4-4 Power Consumption of Typical Household Appliances and Electric Devices**. • For tips on how to save electrical energy around the house, students could visit **www.scienceontario.ca**.
Unit Issue Analysis Project, page 329	Students gather and organize relevant information about two electrical power companies.	• Consider providing research materials for students to use. These might include Websites and brochures. See **www.scienceontario.ca** for some ideas.
	Students make an informed decision, and provide supporting evidence, about which power company is better for the home owner and for the environment.	• Refer students to Science Skills Toolkit 1: Analyzing Issues–Science, Technology, Society, and the Environment, and **BLM G-12 Scientific Research Planner**.

Assessment FOR Learning

Tool	Evidence of Learning	Supporting Learners
Get Ready questions 1, 2, and 3, page 242	Students identify some insulators and conductors. and describe some properties of electricity.	• Create a concept map to help students access and connect prior knowledge they do have related to electricity.
Get Ready question 4, page 243	Students design a step-by-step plan to test an object's ability to hold a static charge.	• Ask students to write, then edit each other's procedure based on the clarity of the instructions given. • Students can use **BLM G-7 Recording an Investigation** to help them develop systematic plans.
Get Ready questions 7 and 8, page 243	Students analyze a table of data to extract information.	• Have students re-order the data in the table from most expensive time to least expensive time.
	Students write a paragraph to encourage reducing the use of electrical energy, addressed to students and school staff.	• Have students work in small groups of three or four to produce a PA announcement that appeals to both staff and students. Encourage each group member to suggest ways to make it more effective. The group can revise the announcement based on this feeback.