Unit Project

Inquiry Investigation
Energy Savings (Student textbook page 328)

Pedagogical Purpose
Students will use an inquiry approach to assess their use of electrical energy and how they can reduce the amount of energy used in one room of their home.

Planning	
Materials	**BLM A-48 Inquiry Investigation Rubric** (optional)
Time	30–40 min in class

Skills Focus
- prepare circuit diagrams
- record data in an appropriate format
- connect inquiry results to the real world

Background Knowledge
Students can obtain energy use estimates from EnerGuide labels or by calculation. You can use this formula to estimate an appliance's energy use:

(Wattage × Hours Used Per Day ÷ 1000 = Daily Kilowatt-hour (kWh) consumption
(1 kilowatt (kW) = 1000 Watts)

Here are some examples of the range of nameplate wattages for various household appliances:

- Aquarium = 50–1210
- Clock radio = 10
- Coffee maker = 900–1200
- Clothes washer = 350–500
- Clothes dryer = 1800–5000
- Dishwasher = 1200–2400 (using the drying feature greatly increases energy consumption)
- Dehumidifier = 785
- Electric blanket- *Single/Double* = 60 / 100
- Fans
  - Ceiling = 65–175
  - Window = 55–250
  - Furnace = 750
  - Whole house = 240–750
- Hair dryer = 1200–1875
- Heater (*portable*) = 750–1500
- Clothes iron = 1000–1800
- Microwave oven = 750–1100
- Personal computer
  - CPU - awake / asleep = 120 / 30 or less
  - Monitor - awake / asleep = 150 / 30 or less
  - Laptop = 50

- Radio *(stereo)* = 70–400
- Refrigerator *(frost-free, 16 cubic feet)* = 725
- Television (colour)
  - 19″ = 65–110
  - 27″ = 113
  - 36″ = 133
  - 53″—61″ Projection = 170
  - Flat screen = 120
- Toaster = 800–1400
- Toaster oven = 1225
- VCR/DVD = 17–21 / 20–25
- Vacuum cleaner = 1000–1440
- Water heater = 4500–5500
- Water pump *(deep well)* = 250–1100
- Water bed *(with heater, no cover)* = 120–380

Activity Notes and Troubleshooting

- As students develop a plan to reduce electricity use, focus their attention on using switches to turn off electricity, as well as the use of power bars and dimmer switches.
- Circuit diagrams should be simple, but should show each load as a parallel connection to the power source, which is household AC.
- The most important part of the revised circuit diagram will likely be the addition of switches.
- Before students begin their work at home, explain exactly how their work will be evaluated. Have them read the assessment checklist in the student textbook, and distribute **BLM A-48 Unit 4 Inquiry Investigation Rubric**, if you will be using it to assess their work.

Additional Support

- Review symbols used in circuit diagrams and emphasize the importance of switches in controlling energy flow.
- DI Bodily-kinesthetic and spatial learners will probably prefer this project to An Issue to Analyze.
- ELL If possible, match English language learners with peers who have demonstrated strong communication ability and a willingness to help. Have these pairs of students clarify each instruction before students go home to gather data; or, invite them to do the project together listing items from both households. Give English language learners time to rehearse their reports and give them the option of presenting to a small group rather than the whole class.
- As an alternative, students could cut out pictures from magazines to show the lights and appliances in their home.

Rubric

ACHIEVEMENT CHART CATEGORY	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	The components of the electrical circuit in the selected room are described with limited accuracy.	The components of the electrical circuit in the selected room are described with some accuracy.	The components of the electrical circuit in the selected room are described with considerable accuracy	The components of the electrical circuit in the selected room are described with complete accuracy.
Thinking and Investigation	A functional circuit board is designed using limited safety practices.	A functional circuit board is designed using some safety practices.	A functional circuit board is designed using considerable safety practices.	A functional circuit board is designed using correct and accurate safety practices.
	The room that uses the most electricity is identified using limited evidence.	The room that uses the most electricity is identified using some evidence.	The room that uses the most electricity is identified using considerable evidence.	Evidence is used with a high degree of effectiveness in identifying the room that uses the most electricity.
Communication	Schematic diagrams are drawn with limited accuracy.	Schematic diagrams are drawn with some accuracy.	Schematic diagrams are drawn with considerable accuracy.	Schematic diagrams are drawn with thorough accuracy.
	The details about the components of the circuit are organized with limited effectiveness.	The details about the components of the circuit are organized with some effectiveness.	The details about the components of the circuit are organized with considerable effectiveness.	The details about the components of the circuit are organized with a high degree of effectiveness.
	The "greener room" is summarized with limited effectiveness according to the criteria of using an appropriate visual format and proper scientific vocabulary and conventions.	The "greener room" is summarized with some effectiveness according to the criteria of using an appropriate visual format and proper scientific vocabulary and conventions.	The "greener room" is summarized with considerable effectiveness according to the criteria of using an appropriate visual format and proper scientific vocabulary and conventions.	The "greener room" is summarized with a high degree of effectiveness according to the criteria of using an appropriate visual format and proper scientific vocabulary and conventions.
Application	The circuit design for the "greener room" is evaluated with limited effectiveness to determine energy savings.	The circuit design for the "greener room" is evaluated with some effectiveness to determine energy savings.	The circuit design for the "greener room" is evaluated in detail to determine energy savings.	The circuit design for the "greener room" is evaluated in considerable detail to determine energy savings.

Please also see **BLM A-48 Unit 4 Inquiry Investigation Rubric**.

An Issue to Analyze
Choosing Energy Sources in Ontario (Student textbook page 329)

Pedagogical Purpose

Students will use an investigative approach to assess social, economic, and environmental costs and benefits of using renewable and non-renewable sources of electrical energy in an energy efficient manner.

Planning	
Materials	Internet access Some useful websites can be found at **www.scienceontario.ca**. **BLM 4-49 Unit 4 An Issue to Analyze Rubric** (optional)
Time	30–40 min in class on two separate days

Skills Focus

- formulate hypotheses to focus research
- identify and locate print, electronic and human sources
- select relevant information on research topics from various sources

Background

In 2008, OPG generated about 70 percent of the electricity in Ontario or 107.8 terawatt hours (TWh). The 2007 generation mix consisted of 45 percent nuclear, 34 percent hydroelectric, and 22 percent fossil-fuelled electricity.

Bullfrog power reports the following:

a) At least 20 percent of the renewable electricity was generated by wind generation facilities, and no more than 80% of the renewable electricity was generated by low-impact water generation facilities and all of the renewable electricity was injected onto the Ontario interconnected electricity grid.

b) At least 20 percent were related to electricity generated by facilities that were EcoLogoM Type III certified and no more than 80% were related to electricity generated by facilities that were EcoLogoM Type II certified.

Activity Notes and Troubleshooting

- Students will need at least two classroom periods to complete this task and will need access to the Internet on both days.
- The websites from Ontario Power Generation and Bullfrog Power are excellent resources for this project.
- You may wish to have students conduct this activity in pairs. This is a good strategy for English language learners. Some English language learners may not have home access to computers or may not have experience using the Internet. Take them to suggested sites and walk them through each or partner them with a student that has strong computer skills.
- Enlist the help of peer helpers from senior physics classes to help with crowd control and help monitor use of the Internet.

Additional Support

- DI Pair students who have strong logical-mathematical skills with those whose skills need developing to activate their pattern-recognition abilities.
- ELL Students new to Ontario may not be familiar with power generation and transmission in Canada. You may wish to pair English language learners with classmates with strong English communication skills.

- ELL Some English language learners will benefit from working through one company first and completing the table with you to ensure they understand the expectations and headings being used. If they are clear on the task have them work with a partner or individually research a second company. Use this information to show them how to write comparative statements using language like "however," "on the other hand," and "as well as," and how to express decisions with data: Company X is better because…

Rubric

ACHIEVEMENT CHART CATEGORY	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	Demonstrates limited knowledge of companies that provide electricity using different energy sources.	Demonstrates some knowledge of companies that provide electricity using different energy sources.	Demonstrates considerable knowledge of companies that provide electricity using different energy sources.	Demonstrates a high degree of knowledge of companies that provide electricity using different energy sources.
Thinking and Investigation	Little information about the different methods of producing electricity is included.	Some information about the different methods of producing electricity is included.	Adequate information about the different methods of producing electricity is included.	Thorough and organized information about the different methods of producing electricity is included.
	Provides no analysis of findings.	Findings not analyzed in a risk-benefit-cost analysis chart.	Findings analyzed in a risk-benefit-cost analysis chart with considerable effectiveness.	Findings analyzed in a risk-benefit-cost analysis chart with a high degree of effectiveness.
Communication	Includes information from a variety of sources using an accepted form of academic documentation with limited effectiveness.	Includes information from a variety of sources using an accepted form of academic documentation with some effectiveness.	Includes information from a variety of sources using an accepted form of academic documentation with considerable effectiveness.	Includes information from a variety of sources using an accepted form of academic documentation with a high degree of effectiveness.
	Uses scientific vocabulary with limited effectiveness.	Uses scientific vocabulary with some effectiveness.	Uses scientific vocabulary with considerable effectiveness.	Uses scientific vocabulary with a high degree of effectiveness.
	Communicates for the chosen audience and purpose with limited effectiveness.	Communicates for the chosen audience and purpose with some effectiveness.	Communicates for the chosen audience and purpose with considerable effectiveness.	Communicates for the chosen audience and purpose with a high degree of effectiveness.
	Provides no summary of information.	Summarizes information in a different format.	Summarizes information into a T-chart.	Summarizes information accurately into a T-chart.
Application	Identifies an issue with limited clarity.	Identifies an issue with some clarity.	Identifies an issue with considerable clarity.	Identifies an issue with a high degree of clarity.
	Supports a position with limited evidence.	Supports a position with some evidence.	Supports a position with considerable evidence.	Supports a position with thorough evidence.
	Describes multiple perspectives with limited accuracy.	Describes multiple perspectives with some accuracy.	Describes multiple perspectives with considerable accuracy.	Describes multiple perspectives with a high degree of accuracy.

Please see also **BLM A-49 Unit 4 An Issue to Analyze Rubric**.