



LEARNING INQUIRIES

THE HOME ENERGY AUDIT

TIME: 60 - 90 MINUTES (CAN BE DIVIDED OVER NUMEROUS BLOCKS)

DEVELOPED BY: DESIREE ARCHER AND TANYA KIRNISHNI



OVERVIEW/FOCUS QUESTION

How is energy produced and transported throughout Canada and how does energy consumption play a role in environmental sustainability?

SUBJECT/TOPIC

**GEOGRAPHY, SCIENCE AND TECHNOLOGY,
MATHEMATICS**

GRADE LEVEL

GRADES 9 - 12

LEARNING GOALS

- Students will be able to define energy.
- Students will be able to identify energy types and locations of different energy sources in Canada.
- Students will analyze their daily energy usage.
- Students will better understand the purpose of energy efficiency and its role in environmental sustainability.

MATERIALS NEEDED

- Electronic devices with access to internet
- Utility bills from home (e.g., electricity bill, heating bill)



CONNECTION TO THE CANADIAN GEOGRAPHY FRAMEWORK

CONCEPTS OF GEOGRAPHIC THINKING

- Interrelationship
- Geographic perspective

INQUIRY PROCESS

- Formulate questions
- Gather and organize
- Interpret and analyze
- Evaluate and draw conclusions
- Communicate

GEOSPATIAL SKILLS

- Technology

LESSON DESCRIPTION

MINDS ON

Students will discuss what they know about energy production in Canada. Through inquiry-based research, students will understand how different energy types are extracted or harnessed and make the connection between types of energy and how we use that energy in our everyday lives.

ACTION

Students will learn about energy consumption and regional differences by looking at their household's utility bills and figuring out average monthly usage and rates. They will also perform an energy audit at home to make connections between energy production and consumption.

CONCLUSION

Students will reflect on their findings and provide recommendations to improve their energy efficiency in their daily lives. In doing so, students will learn about the importance of taking into account how our actions affect the environment.

LESSON IMPLEMENTATION

MINDS ON

Initiate a discussion to highlight what students already know about energy production and transmission. How is energy produced in Canada and what are the different types of energy?

Have students make deductions about which types of energy are produced in their province or territory by asking them to make connections to the different natural resources and geography of their province or territory. Can students identify which resources are renewable and which are non-renewable?

Work with students to define the following terms:

1. Energy
2. Renewable and non-renewable energy
3. Fossil fuel
4. Sustainability

Have a class discussion about the roles that energy plays in students' daily lives (e.g., lighting, heating, transportation, electronic devices, manufactured goods).

ACTION

Ask students to have their parents share with them their most recent bills for energy-related utility services (i.e., heating, electricity). Have them consider the different information presented on these bills. For example, electricity and natural gas bills provide a breakdown of usage over time and cost per unit. For electricity usage, define the meaning of kilowatt and kilowatt hour (kWh) with students.

Have students answer the following questions independently based on their bills:

- What company or companies deliver energy to your home?

- What is the monthly usage for your household for each service (i.e., how much electricity did you use; if your home is heated using natural gas, how much did you use)? If the bill shows data from the previous month or from the same period last year, use that to calculate an average.
- What is the rate your household is charged for each service?

Examine provincial/territorial energy regulator websites (e.g., [Ontario Energy Board](#)) and discuss the concept of time-of-use pricing and on-peak and off-peak hours, referring back to students' household monthly usage. How do these different rates affect their utility bills?

Ask students to submit their data to you anonymously and create a class data set to compare companies, monthly usage and monthly rates. Have students determine the average energy usage and rate per month and calculate what that might work out to per year. Discuss with students how the season might impact the data (e.g., if your class is doing their energy audit in spring, then the heating and lighting costs may be lower and they may need to take that into account for how that may affect their calculations for the yearly average).

The average home in Canada consumes roughly 25,695 kWh (or 92.5 gigajoules, according to [Statistics Canada](#)) per year (this includes all energy types). Ask students to summarize their findings for their monthly energy usage in their homes and compare this to Canada's average. The electricity bill will provide kWh as a unit of measurement, but students may need to do extra research if they have a separate heating bill for natural gas so as to convert the measurement to kWh. What might be missing in their comparison?

The energy sources for electricity and heating can vary from region to region depending on geography. The electricity generation by energy source breakdown for all of Canada is approximately:

- Hydroelectricity (+tidal) – 60%
- Nuclear – 15%
- Natural gas – 9%
- Coal – 9%
- Wind – 4%
- Biomass – 2%
- RPPs (e.g., diesel) and solar – 1%

Have students discuss which provinces might use which energy sources. Not all energy sources are available in all places, whether because of the existing natural resources, the way in which urban centres are laid out, or because of other geographic factors. For example, ask students to research what infrastructure exists around Canada for natural gas. What places are more likely to use natural gas and what places might be more reliant on refined petroleum products and why?

Home Energy Audit

The purpose of the Home Energy Audit is for students to learn more about some of the ways energy is used in their homes—in this case, appliances and electronics. Make sure to discuss with students the concept of phantom power (if appliances/devices are left plugged in, they can continue to draw electricity). Have students follow the steps below and record their results.

1. Choose one room to audit—there should be 5-10 electrical appliances present.
2. Determine the wattage (i.e., power) for each appliance.
3. Over the course of a week, record the time that each of the appliances consumes electricity.
4. Create a spreadsheet with data and have students calculate their energy usage. Use the following formula: Power multiplied by time yields energy consumption (i.e.: Power X Time = Energy Used).

Steps:

- Divide the power of the appliance (measured in watts) by 1,000 to get the kilowatt.
- Multiply the kilowatt by the time spent using the appliance (remember, there are 60 minutes in an hour, so you may have to use decimals to express time) to get the energy consumption in kilowatt hours.

EXAMPLE #1

A microwave that is 1,800 watts is used for 6 minutes.

$$1,800 \text{ W}/1,000 = 1.8 \text{ kW}$$

$$1.8 \text{ kW}/0.1 \text{ hour} = 0.18 \text{ kWh}$$

EXAMPLE #2

A stovetop that is 3,000 watts is used for 1 hour.

$$3,000 \text{ W}/1,000 = 3 \text{ kW}$$

$$3 \text{ kW}/1 \text{ hour} = 3 \text{ kWh}$$

5. Identify which appliances consume energy even when they are turned off and, after doing some research, estimate the energy consumed in standby mode.
6. Have students calculate what their usage is costing them, using their learning from the utility bills.*

*Keep in mind the previous discussions about time-of-use pricing.

CONCLUSION AND CONSOLIDATION

Energy is used for different purposes in the home, not only for powering appliances and electronics. Heating a home accounts for about 63 per cent of Canada's residential energy use, while heating water represents 19 per cent, appliances take up 12 per cent, lighting is four per cent, and cooling about one per cent. Have students reflect on their audit and consider all the ways in which they can be more energy efficient in their own home.

Ask them to do further research and make connections between the types of energy produced in their province/territory and their electricity or heating. For example, if you're using electricity during off-peak hours, which energy source is most likely being used to generate your electricity? Ask students to consider the different environmental impacts of each energy type. Have students submit an individual written reflection about what they learned about energy from their work with the utility bills, energy audit and other research. Alternatively, they can work in groups to do an oral presentation.

Students should now have a better understanding of the different types of energy that Canada produces, be able to differentiate between renewable and non-renewable energy sources, and understand what role energy plays in their home. Encourage students to think about ways in which they can be more energy efficient and/or reduce their impact on the environment (e.g., [energy-efficient appliances](#), installing solar panels, using electricity at off-peak times).

Consider the following questions:

- Why should students care about energy efficiency?
- What role does energy efficiency play in our efforts to live in a more sustainable environment?
- As the global human population increases, what effect does this have on the demand for energy?

- Do options for more renewable energy sources differ for rural/remote communities and urban centres? What role does geography play? What are some of the challenges with making renewable energies more efficient and reliable energy sources for the long term?

EXTEND YOUR GEOGRAPHICAL THINKING

To learn more about energy use, students can also look at their methods of transportation. Students can use Natural Resources Canada's [Fuel Consumption Rating Search Tool](#) to learn about mileage and CO2 emissions for their vehicle type. If they take the bus or go on vacations abroad, they can research fuel consumption/emissions for those vehicles. How does fuel consumption contribute to students' energy use? Are there more sustainable options available to students for daily transportation needs? What about mitigating the environmental impact of travel?

Another extension to the project could include a research project on a current energy issue in Canada (e.g., the construction of new infrastructure for energy production and transmission, such as building a new pipeline or siting a new wind farm). How does this energy issue affect students and/or their community (e.g., environmental concerns, economic opportunities)? How does it affect the world (e.g., greenhouse gas emissions, trade in energy resources)?

MODIFICATIONS

Students can do independent or group research on individual types of energy and present to the class.

Students can work in groups to compare and contrast their findings of their Home Energy Audit. They can also do a more in-depth audit of their entire home as well as their transportation habits.

ASSESSMENT OPPORTUNITIES

Teachers can observe and assess students' participation in class discussions.

If teachers decide to have students do independent or group projects, then they can assess students' written work or oral presentations.

Teachers can assign math and comprehension tasks based on the sample calculations provided in the activity.

SOURCES AND ADDITIONAL RESOURCES

Explore the [Energy IQ](#) website to find videos, infographics, and factbooks to gain a deeper understanding of Canada's energy mix landscape.

Natural Resources Canada - [Energy Facts](#) provide information about Canada's various energy sources.

Canada Energy Regulator - [Provincial and Territorial Energy Profiles](#)

Learn about Canada's oil and natural gas, as well as the world's energy needs, with the [Canadian Association of Petroleum Producers](#).

Natural Resources Canada - [Energy Sources and Distribution](#)

[Canadian Wind Energy Association](#)

[Canadian Nuclear Safety Commission](#)