Canadian Geographic EDUCATION

ENERGY IQ

LEARNING INQUIRIES

ENERGY AND OFF-GRID COMMUNITIES IN REMOTE CANADA

TIME: 40-50 MINUTES

DEVELOPED BY: CANADIAN GEOGRAPHIC EDUCATION

OVERVIEW/FOCUS QUESTION

Using the Energy Production and Transmission Giant Floor Map or tiled map, students will locate off-grid communities in remote northern communities across Canada and discuss the geographic locations of these communities and access to resources in these regions. Students will then think about how these communities could gain access to energy in different ways.

SUBJECT/TOPIC

ACCESS TO ENERGY, CANADA'S NORTH

GRADE LEVEL

7-9

LEARNING GOALS

Students will:

- Analyze a map of Canada to explore off-grid communities, as well as energy facilities and transmission lines in the country.
- Explain how a community's location and geography could affect its ability to access energy.
- Investigate how off-grid communities could gain access to energy sources.

MATERIALS NEEDED

- Energy Production and Transmission Giant Floor Map or tiled map
- Devices with Internet access (1 per group)
- Communities in the North worksheet (1 per group)
- Clipboards (1 per group)

CONNECTION TO THE CANADIAN GEOGRAPHY FRAMEWORK

CONCEPTS OF GEOGRAPHIC THINKING

- Spatial significance
- Patterns and trends
- Interrelationships

INQUIRY PROCESS

- Interpret and analyze
- Evaluate and draw conclusions
- Communicate
- Reflect and respond

GEOSPATIAL SKILLS

- Foundational elements
- Spatial representations
- Technologies

LESSON DESCRIPTION

MINDS ON

Students will discuss the definition of an off-grid community and learn where they are located in Canada.

ACTION

Students will explore the Energy Production and Transmission map and locate communities not connected to the North American electrical grid or natural gas pipeline system. Students will complete a worksheet to help them inquire into how geography might affect a community's ability to access energy and ways communities could acquire energy.

CONCLUSION

Students will brainstorm how energy can reach remote and off-grid communities.

LESSON IMPLEMENTATION

MINDS ON

Gather students around the Giant Floor Map or assembled Energy Production and Transmission tiled map. Ask them to determine what the different lines and symbols represent using the legend. Now, ask students what they notice about where the transmission lines and facilities are located. How do they differ in the north, south, east and west of Canada?

Explain that, throughout Canada, there are communities not connected to the North American electrical grid and natural gas pipeline system. Today, students will be learning about off-grid communities in provinces and territories in northern Canada specifically. Ask students what they think is the definition of an off-grid community. Explain to students that an off-grid community is one that is not connected to a provincial, territorial or North American electrical grid or natural gas transmission line. These communities will often use diesel-fired generation for their energy needs (communities that have their own small regional grid may supplement that with other energy sources, such as hydroelectricity).

Focusing on Canada's northern region, ask students what they notice about the transmission lines and facilities. Students might notice fuel oil, hydroelectric and wind facilities, as well as diesel shipments by sea routes, natural gas and crude oil pipelines and electrical transmission lines. Ask students to compare the transmission lines and facilities in the North with the rest of the country. Are transmission lines bigger or smaller in the North? Ask students to focus on the lines in the water. What do these lines represent and why are they important to communities in the North? Explain that students will be focusing on the geography of Canada's northern region and how it might affect access to energy for some communities.

ACTION

Looking at the map, discuss with students what communities they think would be off-grid and why. For an interactive map of communities that are not connected to the North American electrical grid and natural gas pipeline system, visit Canada's Energy Regulator's Market Snapshot from 2018. Note that some of these communities are connected to a provincial or territorial grid as their main power source but not to the North American electrical grid, as indicated on the legend.

Before you begin the activity, review with students how to determine locations using coordinates. Remind students what the terms latitude and longitude mean and have them identify these lines on the map. Latitude and longitude are measured in degrees and are used to help locate things (e.g., cities, monuments, destinations) on a map. Some coordinates also use minutes and seconds as well as degrees. For the purposes of this activity, only decimals will be used.

Explain to students that latitude lines run horizontally and longitude lines run vertically. Remind students where the equator and the prime meridian are located (as they are not shown on the Energy Production and Transmission map). To help them practice remembering which is longitude and which is latitude, ask students to stand on a latitude line north of the latitude line marked 50°. Now ask them to stand on a longitude line east of the longitude line marked -116°, then on a latitude line located south of the latitude line marked 64° and a longitude line west of the longitude line marked -74°. Continue as long as necessary to help students become familiar with latitude, longitude and cardinal directions.

Review with students what the numbers in a set of coordinates mean. The first group of coordinates in a set is the latitude. A letter "N" (north) or "S" (south) measures the distance either north or south of the equator (which is located at 0 degrees latitude). The second set of numbers is the longitude. The letter "W" (west) or "E" (east) measures the distance either west or east of the prime meridian (which is located at 0 degrees longitude).

There are a few ways to write coordinates (for example, as mentioned above, using degrees, minutes, seconds or just degrees). If there are no letters indicating cardinal direction, just numerical coordinates, a negative symbol (-) before a coordinate will indicate that the coordinate is south of the equator (for latitude) or west of the prime meridian (for longitude). No symbol before the coordinate indicates that the coordinate is positive and therefore north of the equator (for latitude) or east of the prime meridian (for longitude). Maps may also have a negative symbol (-) beside a longitude line measurement if it is west of the prime meridian, or beside a latitude line measurement if it is south of the equator. This means a longitude coordinate of 79.3871° W would be close to the longitude line marked -79° on a map.

To help students practice locating coordinates, ask a student volunteer to locate their hometown on the map. Now ask them to identify the coordinates of the city using decimal coordinates. Clarify any confusion or misunderstandings that arise. Practice using other major cities if needed.

Gather students off of the map. Divide students into groups of four students. Each group will be locating a different community on the map based on given coordinates and brainstorming ways this community and other communities in the North could access energy.

These are coordinates of just some of the communities that are not connected to the North American electrical grid and natural gas pipeline system and use diesel as their main power source. There are many more off-grid communities across Canada, some that use power sources other than diesel. If there are not enough students to locate all of the following communities, you have the option to make the groups smaller or to assign only certain coordinates (it will not affect the lesson).

- 63.7467° N, 68.5170° W (Iqaluit, Nunavut)
- 72.7001° N, 77.9585° W (Pond Inlet, Nunavut)
- 69.1169° N, 105.0597° W (Cambridge Bay, Nunavut)
- 61.1078° N, 94.0624° W (Arviat, Nunavut)
- 56.5408° N, 79.2232° W (Sanikiluak, Nunavut)
- 61.8628° N, 121.3530° W (Fort Simpson, N.W.T.)
- 67.4364° N, 134.8808° W (Fort McPherson, N.W.T.)
- 60.0628° N, 128.7109° W (Watson Lake, Yukon)
- 55.2746° N, 77.7638° W (Kuujjuarapik, Que.)
- 58.1030° N, 68.4188° W (Kuujjuaq, Que.)
- 54.9939° N, 85.4277° W (Peawanuck, Ont.)
- 55.9907° N, 87.6330° W (Fort Severn, Ont.)
- 58.7196° N, 111.1407° W (Fort Chipewyan, Alta.)
- 56.5417° N, 61.6969° W (Nain, N.L.)

Hand out one Communities in the North worksheet to each group. Go over the sheet with students before they begin. Explain that you will be assigning each group a set of coordinates. Students will first need to locate their community on the map using the coordinates. Then they should think about how the geography of the location would affect the community's access to energy. What unique challenges do communities in the North face when it comes to accessing energy sources? Students can use Google Earth on their devices to more closely explore the

geography of the area. Students will then brainstorm how energy could be sourced, transported or distributed to that community and what challenges would need to be overcome. Once you have explained the activity, assign a set of coordinates to each group (have students circle their set of coordinates on their worksheet) and have them complete the worksheet.

CONCLUSION AND CONSOLIDATION

Regroup students around the map and have them share the name of their community and their ideas about why the community is off-grid and how it could meet its energy needs.

Discuss with students what should be considered when planning transmission and distribution routes and energy facilities in the North. Discuss the important role that Indigenous communities would have in discussing how to meet energy needs in the North.

EXTEND YOUR GEOGRAPHICAL THINKING

- Use the *On Top of the World* lesson plan found in the Teacher's Guide for the Energy Production and Transmission Giant Floor Map to learn more about the energy resources of the North.
- Have a member from a provincial or territorial energy company speak with your class about how they work to meet the energy needs of the communities they serve.
- Research how the types of energy sources and access to these sources affect the standard and cost of living in the North.
- Examine how Indigenous communities are working to meet the energy needs of communities in the territories.

MODIFICATIONS

- An adapted version of this activity can be completed with the interactive energy map on the Energy IQ website to show students the energy facilities and energy transmission lines, along with Google Earth, to help them locate communities according to the coordinates. Note that this map does not include diesel shipping routes.
- Instead of in groups, worksheets can be completed as a class.
- To space out students on the map, half of the groups can explore their communities on the tiled map while the other half can use Google Earth to research their community's geography. Then groups can switch.

- Complete an example of the worksheet with one community to help students understand the activity.
- Extension: Students can complete a research project on an off-grid community and how its energy needs are met.
- Extension: Students can create a proposal for an energy facility in the North, researching potential costs, feasibility, groups and communities who should be involved and environmental considerations.
- Extension: Research new projects that are seeking to bring energy to remote communities, such as the Wataynikaneyap project in Ontario.

ASSESSMENT OPPORTUNITIES

- Observational notes can be taken during discussion periods.
- Teachers can assess students' worksheets.

SOURCES AND ADDITIONAL RESOURCES

- Learn more about energy in Canada and explore an interactive energy map on the Energy IQ website.
- For an interactive map of communities that are not connected to the North American electrical grid and natural gas pipeline system, visit Canada's Energy Regulator's Market Snapshot from 2018.
- Learn about power in Nunavut through the Qulliq Energy Corporation's website.
- Explore Yukon's energy through the Yukon Energy website and the ATCO Electric Yukon website.
- Learn about Northwest Territories Power Corporation and how energy gets to communities in the Northwest Territories.
- Explore provincial and territorial energy profiles through Canada Energy Regulator's Provincial and Territorial Profiles.
- Check out this Energy Poverty video.

STUDENT ACTIVITY SHEETS

COMMUNITIES IN THE NORTH

Instructions:

1. Circle the coordinates and community given to you by your teacher in the table below.
2. Find the community on the map using the coordinates.
3. Study the community's geographical location and use your knowledge about Canadian geography, transportation and energy to answer the questions on this worksheet.

Name(s): _____

Coordinates and community name (circle one)

63.7467° N, 68.5170° W (Iqaluit, Nunavut)	60.0628° N, 128.7109° W (Watson Lake, Yukon)
72.7001° N, 77.9585° W (Pond Inlet, Nunavut)	55.2746° N, 77.7638° W (Kuujjuarapik, Que.)
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COMMUNITIES IN THE NORTH

1. What geographical features do you notice in the area surrounding your community? For example, are there mountains, ice, or rivers?

2. How might the community's location affect its ability to get energy?

3. How could a community in this area get the energy it needs? Would transporting and distributing various energy sources be possible? What energy facilities might be practical in this region?