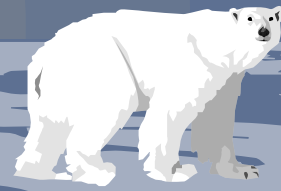


Climate Change – Our Permafrost Past, Present and Future



Learning Objectives:

- Give examples of how human activity affects the atmosphere (e.g., types of atmospheric pollution).
- Explain the causes and possible effects of climate change.
- Describe possible responses to climate change.
- Explore the impact of human activity on the atmosphere and, by extension, on global climate change and ozone depletion.
- Examine the impact of melting permafrost on communities, flora and fauna.

Materials:

- Giant Floor Map “Canada from Space”
- Chains
- KLQ chart for each student (1)
- Blocks
- Devices with Internet access
- Discussion Questions card
- *Studies in Physical Geography Student Workbook* (Henry P. Sovio), Green Heron Publishing, Surrey, B.C., 2017 (optional)
- Copies of maps of each province and territory for each group (optional) (canadiangeographic.com/educational_products/tiled_map_canadian_provinces_territories.asp)

Targeted Levels:

- Grades 9 to 12

Introduction

Choose from the following suggested resources to launch a discussion about the effects of climate change:

- ▷ Read Chapter 34: “Climate Changes Trigger Biome Changes,” pp. 152–154, in *Studies in Physical Geography Student Workbook* (Henry P. Sovio), Green Heron Publishing, Surrey, B.C., 2017
- ▷ Look over the Arctic ice time cards from the Giant Floor Map trunk: canadiangeographic.com/educational_products/activities/canada_from_space/6_arctic_time_cards.pdf
- ▷ Look at maps of permafrost from reliable sources, such as the Canadian Cryospheric Information Network: ccin.ca/ccw/permafrost/current
- ▷ Explore climate change from different perspectives: Canadian Space Agency (asc-csa.gc.ca/eng/satellites/everyday-lives/climate-change.asp), Canadian Cryospheric Information Network (ccin.ca), Natural Resources Canada (nrcan.gc.ca/environment/resources/publications/10766)
- ▷ Look over these climate change infographics: canadiangeographic.com/educational_products/products_climate_change.asp
- ▷ Explore the importance of using satellite imagery to better understand climate change and keep people safe:
 - “Space serving the Arctic and the Great Canadian North” (asc-csa.gc.ca/eng/satellites/everyday-lives/space-serving-the-arctic-and-the-great-canadian-north.asp) and
 - “RADARSAT-2 helps create permanent road link to Arctic Ocean” (asc-csa.gc.ca/eng/blog/2017/12/13/radarsat-2-helps-create-permanent-road-link-to-arctic-ocean.asp)

When introducing the effects of climate change, bring some of the following ideas into the discussion: the warming of lakes and rivers, plant and animal migration, higher sea levels, desertification, increased risk of lightning storms, more/bigger wildfires, stronger winds, pests and harmful fungi spreading further north with milder winters, etc.

Development

Divide students up into groups and assign each of them a territory/province that has permafrost. Have each student use Google My Maps to draw the borders for the past, present and future permafrost regions based on what they have found (using websites, Arctic ice time cards, climate change infographics, etc.). Students should then print out their My Map to use as a reference for the Giant Floor Map. Alternatively, provide each group with a photocopy of their territory/province to draw on. Use the following websites to help students determine past, present and future permafrost regions:

- ▷ biodivcanada.ca/3ED0C589-F00E-40D3-A9D3-4D4DEF1A8E7E/2816No.9_Permafrost_November_2011_E.pdf (page 1 features a map showing permafrost coverage in 1995)
- ▷ ccin.ca/home/ccw/permafrost/current (current)
- ▷ ccin.ca/home/ccw/permafrost/future (predictions for 2050 and 2100)
The map shows the predicted thawing of permafrost. The yellow represents areas that will remain frozen in 2100; however, the red and orange areas show the regions that will be thawed by 2050 and 2100, respectively.



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Using their maps, have students place a line of blocks on the Giant Floor Map to show the past line of permafrost. Once all students have finished placing their blocks, have them add coloured chains to show the current line of permafrost for their territory/province. Finally, have students stand on the map to outline where the future line of permafrost is predicted to be.

Discuss with your students what they observe from the outlines they have made on the map. What is the rate of change for permafrost coverage (estimate the change in kilometres per year)? What human activities affect permafrost? How do they affect it? What possible future effects could the changing permafrost have on each territory/province and in particular on the Yukon?

Have students think about the impact on flora and fauna, the atmosphere and ozone layer, buildings and infrastructure, and their own way of life. Are there things they will have to do differently? How can humans respond to climate change?

How will the melting of permafrost affect outdoor activities? (Think of snowmobiling, quadding, hunting, fishing, trapping, etc.) Have students use the map to show where they might do these activities.

Guide students to establish connections on the map between their local community and other places in Canada that may be affected by melting permafrost. Have them compare locations. How are they similar? How are they different? Have students discuss what these changes could mean for Canada.

Conclusion

Use the Discussion Questions card to engage students in a review of what they have learned and to encourage them to think further on selected topics. Alternatively, have students choose a couple of questions and answer them in the last few minutes of class as part of a wrap-up assignment.

Extend Your Geographical Thinking

Show students the following videos: “Causes and Effects of Climate Change | National Geographic” ([youtube.com/watch?v=G4H1N_yXBIA](https://www.youtube.com/watch?v=G4H1N_yXBIA)) and Catherine McKenna’s conversation with Chris Hadfield about climate change ([youtube.com/watch?v=PE5PJKemo6Q](https://www.youtube.com/watch?v=PE5PJKemo6Q)).

Have students choose one of the topics from the videos (e.g., the destruction of the Aral Sea, overpopulation, greenhouse effect) and prepare a straight-to-the-point 2-minute presentation to elaborate on the topic. Students in the audience will fill out a KLQ chart.

Set-up:

Photocopy KLQ charts for each student. Depending on the age of your students, you may want to introduce the topic of ice monitoring and climate change using “Activity 6: Canadian Ice Service” found in the binder or online (canadiangeographic.com/educational_products/canada_from_space_map.asp).

