

Effects of Global Warming Activity: Permafrost

Permafrost is persistently frozen soil that has been frozen for two or more years. It consists of large cavities of pure ice and ground ice, or ice that forms in pore spaces and bonds sediments in the soil. About a quarter of the northern hemisphere's land, including much of Alaska, contains permafrost. Although these regions have been in the permafrost zone for thousands of years, today all regions are reporting thawing and a decrease in permafrost. Scientists attribute melting permafrost to increased atmospheric warming.

Watch at least two of the following QuickTime videos:

- Melting Permafrost
- Losing Permafrost in Alaska
- Changing Arctic Landscape

Record in your science notebook the environmental, economic, and cultural consequences of warming as is highlighted in the videos. When you are finished, discuss your ideas with your group.

Class Presentation

Your group will be presenting important background information to a panel at a special Congressional hearing on the subject of permafrost. The panel has no scientific expertise, so you will need to demonstrate what permafrost is and explain the consequences of its melting in clear, concise terms.

With your group, create an experimental model of permafrost to use in this exercise. Start by collecting enough local soil to fill a cardboard box that you can fit into a freezer at home or one made available by your school. Before you put the soil into the container, take a hand spray (or similar device) and spray the soil with water until it is wet throughout. You may have to stir the soil to make sure it all gets wet. Put the soil into the cardboard container and place the container in a freezer overnight.

Begin your presentation with an overview that defines permafrost. Explain how it forms and how prominent it is in Alaska. List obvious signs that it is melting—including changes to the landscape and the sinking of built structures. To demonstrate the change permafrost undergoes when it melts, build or place a structure on your frozen model, then allow the frozen soil to thaw. (Note: The structure should be heavy enough that when the soil is thawed, it begins to sink or shift position. You may experiment with different kinds of materials for the structure, such as metal, stone, and wood.) Also, be sure to make a drain hole in the box to allow meltwater to escape.

Before the soil has finished thawing, ask the panel to guess what will happen to your model. Describe the outcome and explain how this relates to what is happening to permafrost in Alaska. To demonstrate the local and global significance of melting permafrost, your group should highlight such consequences as erosion, the disappearance of lakes, the dilution of oceans from freshwater runoff, and accelerated atmospheric warming as ice cover diminishes and trapped greenhouse gases escape.

Effects of Global Warming Activity: Subsistence Living and Your Carbon Footprint

Most indigenous peoples, including Alaska Native peoples, possess a holistic worldview. They see all elements—earth, air, fire, water, and spirit—as interconnected. Often, their traditional ways of life provide all their material needs. However, global warming is driving changes that threaten time-honored Alaska Native practices, including subsistence living.

Watch at least two of the following QuickTime videos:

- The Spirit of Subsistence Living
- Gwich'in Tribe Protects Caribou and Culture
- Living from the Land and Sea

In your science notebooks, reflect on the similarities and differences between Western and Alaska Native ways of life. What skills are essential for survival in the Arctic? How about in Western societies? In what ways do global warming and Western influence threaten customary practices? Why are both Alaska Native and Western scientific knowledge important in managing Alaskan resources? Discuss your ideas with your group.

As a group, visit the Web site, Carbon Footprint (<http://www.carbonfootprint.com/index.html>). Read the "What Is It?" tab, and check out the "Calculator" feature.

Class Presentation

You will be presenting to a room full of business executives, including representatives from the automobile, airline, clothing, construction, and supermarket industries. Your group will need to educate these executives about the impact their current practices are having on the planet.

Explain the idea of a carbon footprint and suggest practices that Western societies could adopt to help reduce their carbon footprint. For example, it might help to compare the different kinds of food on the dinner table in different cultures, including Alaska Native communities, or the style and type of dress, including an analysis of where these foods and clothes come from and how this may impact one's carbon footprint. (Note: Displaying actual examples of clothing to make a comparison might be effective here.) Most people in rural Alaska have to travel by snow machine, motor-powered boat, or airplane. Assess the carbon footprint of a typical local subsistence hunting or fishing activity, and what the footprint would be to fly round-trip to the nearest large city. To provide added context, be sure to address the impact that carbon from factory emissions and transportation and the depletion of natural resources are having across the planet. For example, even though forests are being cut down in remote rainforests to produce lumber and furniture, the reduction of trees hinders the planet's ability to process the important greenhouse gas carbon dioxide. Thus, deforestation is a concern that might be shared by everyone, everywhere.

Extension Activities:

- Compare your carbon footprint today with that of your parents or grandparents at your age.
- Develop a carbon footprint reduction plan for your school.

Effects of Global Warming Activity: Contaminants

While Alaska and other Arctic and sub-Arctic regions lack most of the pollution sources commonly found in industrial cities and agricultural areas throughout the world, contaminants migrate to northern latitudes by natural and human processes. For example, particulates, which include sulfur compounds from factories and black carbon from automobile exhaust, arrive by air thousands of miles from their sources. First among the contaminants that cause concern due to their toxicity are organochlorines, including PCBs (polychlorinated biphenyls) in oil. PCBs directly threaten the safety of subsistence foods, as Alaska Native peoples living near the site of the *Exxon Valdez* oil spill can verify. Because sea ice is melting more rapidly and to a greater extent during the year, shipping in Alaska and the Arctic is expected to increase, making it more likely that oil spills will occur. Global warming is also altering the recovery of areas affected by oil spills.

Watch at least two of the following media resources:

- What Happens When an Oil Spill Occurs? (Flash Interactive)
- Oil Contaminants Hidden from View (QuickTime Video)
- Safeguarding Alaska's Waters (Flash Interactive)
- Contaminants in the Arctic Food Chain (QuickTime Video)
- Contaminants in the Arctic Human Population (QuickTime Video)

In your science notebooks, write down some of the contamination sources and the means by which the contaminants travel. Be sure to note their varied effects on the physical environment and the living things it supports, as well as the connection between contaminants and the health, culture, and well-being of Alaska Native peoples. As a group, discuss some of the proposed or ongoing ways to combat the problems that contaminants present. Do the proposed ideas seem like effective solutions for the problems? Why or why not?

Class Presentation

You will make your presentation on the effects of contaminants on human health to a global health conference. Choose one of several toxic pollutants found in Alaska's ecosystems. Prepare a definition of the pollutant and a diagram that depicts how it travels from its likely source to the environment, including to plants, animals, and humans. You may need to do some additional Internet research to gather this information. For example, some Arctic peoples are concerned with the growing incidence in their region of upper respiratory problems. In addition to your own research into what may be causing this breathing disease, ask your teacher to arrange for email communications with students from areas where exposure to contaminants is high. Interview them to get their concerns on record and relate their words to the review panel. In your presentation, mention some effects that contaminants entering the Arctic from outside sources consequently have on the global community. In particular, discuss the effects of contaminants infiltrating the food chain (i.e., bioaccumulation).

Effects of Global Warming Activity: Arctic Haze

[optional for Alaska Native students]

Arctic haze is a reddish-brown air mass that forms in the atmosphere at high latitudes, including over Alaska. It is the result of pollutants in the atmosphere and is similar to the smog caused by automobile and industrial emissions that hangs over large metropolitan cities. In a region already experiencing fast-paced temperature change due to global warming, Arctic haze can linger for more than a month and trap additional heat.

Watch the Arctic Haze QuickTime Video.

In your science notebooks, jot down the impact that the atmospheric particulates that form Arctic haze are having on various aspects of Arctic life. Next, interview Elders whom you know to get a sense of how much the sky and air have changed in their lifetime. Try to gauge how haze changes seasonally and the effects it has on the environment. What do these Elders perceive to be the cause? How do they feel about this? What do they think should be done to correct these problems? Read the "Elders in the Classroom" PDF Document for suggestions on how to appropriately contact and interview Elders. You may also choose to interview hunters, fishermen, and men and women who handle food for their insights into how airborne pollution impacts animal life.

Class Presentation

You will be making your presentation to a United Nations panel on air pollution. Explain the phenomenon of Arctic haze to the delegates in attendance. Compare it with distinctive forms of pollution found in other places across the world. Then, describe what Elders and others said in their recollections of how the sky and air have changed over the years. Discuss with your classmates what can or should be done to eliminate Arctic haze. Because the source of this form of pollution is remote to the region, any significant changes to industry or individual practices might involve both national and international governing bodies. Include in your presentation what cases you would make to each body and the scientific basis for your arguments. Be sure to cover the concept of a positive feedback loop and why trapping heat that is already accumulating in polar regions is something all parties contributing to Arctic haze should seek to avoid.