

Lesson Plan

Description
 As temperatures increase, the rate at which glaciers melt is increasing. This is having serious consequences on the way of life of many, including the Inuit people who are forced to adapt to these changes. This lesson looks at the effect of melting glaciers and what is being done to adapt.

- Learning Outcomes**
- Glacier melt has increased drastically due to climate change and has caused rising sea levels
 - Rising sea levels have created detrimental effects on the planet. These effects include coastal erosion and increasingly intense and frequent natural disasters
 - Sea ice melt has elevated global temperature due to the albedo effect
 - Students will learn about permafrost and its importance to the communities that are built upon it
 - Inuit communities have had to change and adapt their fundamental way of life and culture due to the impacts of climate change

- Specific Expectations**
- A3.2** investigate how science and technology can be used with other subject areas to address real-world problems
- A3.3** analyse contributions to science and technology from various communities
- E1.2** demonstrate an understanding of First Nations, Métis, and Inuit knowledges about water, connections to water, and ways of managing water resources sustainably
- E2.4** identify factors, including climate change, that have contributed to the melting of glaciers and polar ice-caps, and describe the effects of this phenomenon on local and global water systems

Introduction

Glacier Melt

Ice found on land and in water maintains many kinds of life in areas such as the Arctic and is crucial for the survival of various types of species. Due to the climate crisis, global temperatures are rising swiftly. This has caused the rate of glacier melt to skyrocket since warmer temperatures causes rain to fall rather than snow. Additionally, when a glacier melts into the surrounding water, it has more contact with the water’s surface and further accelerates the melting process.

Melting ice, such as glaciers, that are found on land are responsible for rising sea levels, not ice found in the water. Furthermore, as sea levels rise, there is more coastal erosion. This means that there are strong waves and flooding that cause rocks, soil, and/or sand to be worn down and carried away along coasts around the world.

The rising sea levels due to glacier melt can also cause further warming of the air and ocean temperatures which creates more intense and frequent coastal storms such as hurricanes and typhoons.

Sea Ice Melt

Even though sea ice found in water does not directly contribute to rising sea levels, it does have further consequences to Earth's overall climate. Sea ice is light in colour, this means that it reflects the sunlight that beams upon it back into the atmosphere. This is otherwise known as the albedo effect. Since sea ice is melting at a rate of more than 10% every 10 years, oceans are becoming darker in appearance. This means that sunlight is not being reflected as it should, and the water's temperature is continuously increasing. This in turn causes warmer air temperatures, an interference with the pattern of ocean circulation which then contributes to the cycle of global warming by increasing glacier melt.

Permafrost

Permafrost is any ground that continuously remains frozen for at least 2 years straight and is harder than concrete. It is made up of soil, rocks, and sand that are held together by ice. It is the foundation of most northern Canadian communities which upholds their infrastructures such as roadways, buildings, and bridges of the populations that live in the area. With an increase in air temperature and rates of precipitation, permafrost conditions have changed drastically. Warming and thawing of permafrost can cause subsidence (sinking of the ground caused by underground material movement) and settlement of the ground. This can cause problems with the foundation of houses and building as well as the possibility of landslides.

In addition, melting permafrost releases greenhouse gases such as carbon dioxide and methane which can cause higher levels of global warming and climate change. It can also cause ancient bacteria and viruses that are found in the ice and soil to be liberated in the surrounding environment which can make humans and animals very sick.

Effects on Inuit Communities

Sea levels have risen by 3.4 mm per year since 1993 which has caused a total increase of approximately 9.86 cm in 2022 (98.6 mm).

People from all over the world are affected by the rapidly rising sea levels and the effects it has, such as the ones that were previously mentioned. With the vanishing of sea ice and rapidly melting glaciers, Indigenous peoples are disproportionately affected by climate change.

For example, the Inuit population of Canada's Arctic are permanently losing their ability to stay in touch with their basic way of life, culture, as well as their traditions that have endured

for hundreds of years. “The land is not just the land for them. It’s family, it’s kin, it’s part of you. Every aspect of Inuit culture grows from the land,” said Ashlee Cunsolo, director of the Labrador Institute in Happy Valley-Goose Bay in a 2018 article by *The Guardian*. They have had to change their hunting strategies and live with the danger of the vanishing ice that makes up their surroundings. As the sea ice shrinks and the weather becomes more severe, travel has become progressively riskier, and members of northern communities are unable to visit other surrounding areas or make their way to their traditional hunting lands.

As previously mentioned, Inuit are incredibly resilient and have learned to adapt to their swiftly changing environment. Hunters have made a move from sea ice to land and made a change in the animals that they hunt; they now hunt more caribou rather than animals like seals as well as fish. Inuit hunters have also started keeping a close eye on the changes in wildlife populations as well as their migration patterns. Although when hunters and fishermen are unable to safely gather food, Inuit have had to start relying on highly expensive, store-bought processed foods.

Material

Activity 1: Glacier Melt

- Two small, clear, and identical containers
- Food colouring
- Timer
- Ice cubes that have been dyed with food colouring – At least 4 in total
- Water – Room temperature

Activity 2: Melting Sea Ice

- Ice cubes – At least 2
- Dark coloured cloth – Black is ideal
- Light coloured cloth – White is ideal
- Lamp or window with lots of light

Activity 3: Permafrost

For permafrost build:

- A clear container (1/group) – Tupperware, large baking dish, organization bin (9” x 13”)
- Ice cubes (Approximately 6+/group)
- Soil and/or sand – Enough to fill the container half-way
- Small rocks to be mixed in with soil and/or sand
- Water (2 cups/group)
- Large bowl
- Large spoon for mixing

For house building:

- Toothpicks and/or wooden skewers
- Modeling clay and/or play dough
- Popsicle sticks
- Construction paper
- Scissors
- Tape
- Glue
- Strong
- Piper cleaners
- Recycled material such as toilet paper rolls, paper towel rolls, water bottles, etc.

Action

Activity 1: Glacier Melt

This activity requires some preparation.

1. At least 4 hours in advance, freeze the ice cubes after adding food colouring. Food colouring is not mandatory but helps students observe the ice's melting process.

Once the ice is prepared:

2. Add an equal amount of ice to each identical container. These will act as the glaciers that have been discussed in the introduction section.
3. To one of the containers, add approximately $\frac{1}{4}$ cup of water to the bottom of the container. This symbolizes rising sea levels which cause glaciers melting rate to accelerate.

To keep track of the ice cube's melt, set a timer and check on them approximately every 10 minutes. Students should note their observations with their handout sheet.

As the students are observing the ice melt, prompt them with the following questions to check for learning and encourage classroom discussion.

- What do you think will happen with each set of ice cubes?
- What do you think would happen if we conducted this experiment in a very cold room, or set them in the fridge instead of our room temperature classroom?
- What would a cold room signify during this experiment? What does a warm room signify?
- What impact do melting glaciers have on the people of Canada, including Inuit communities?

Activity 2: Albedo Activity

This activity requires some preparation.

1. At least 4 hours in advance, freeze the ice cubes.

Once the ice is prepared:

2. Put the two pieces of light and dark cloth next to a window or underneath a lamp.
Ensure that they are placed side by side
3. Set an equal amount of ice cubes on each piece of cloth

Over the next couple of hours, students should note their observations of the ice melt in their handout.

Activity 3: Permafrost

Part 1: Preparing the permafrost

This activity requires some preparation a day in advance.

1. Separate students in groups of 2-4 students according to class size.
2. In each group's container, begin by combining the rocks, 2/3 of the sand and/or soil together with enough water to moisten the soil.
3. Once the bottom layer has been prepared, place the 6 ice cubes across the layer of soil to imitate large pieces of ice that are found in permafrost.
4. For the third and final layer, combine the remaining 1/3 of sand and/or soil with enough water to moisten it in a large bowl.
5. Once mixed together, add the damp sand and/or soil on top of the ice cubes on a flat layer.
6. Set each groups container of soil mixture in the freezer overnight and do not remove until you are ready to begin the second portion of the activity.

Part 2: Building houses

It is best if this activity is done first thing in the morning in order to observe the changes of the permafrost as they occur throughout the day.

1. Organize students into their designated groups. Their first task will be to observe the given resources that are provided to them in order to assemble their houses, and then create a plan for their build using some blank paper and a pencil. They must keep in mind that their house must fit inside of their container for the overall activity to work as planned.
2. After they have created their plan, have students collect their material and build their homes. It may be beneficial to set a 10 to 15-minute timer during the building process to keep students on track and add another level of challenge to the activity.
3. Once they have completed building their houses, each group will set their creation on the permafrost they made the day before.

4. Using their observation sheet, each group will note their observations of the thawing permafrost after 1-hour intervals as well as overnight. Students should notice a change in the balance of their structure as well as “crater” like spots where the ice cubes have melted and have filled with water. This is an example of settlement and subsidence that occurs in northern communities as permafrost thaws at a rapid pace.

Consolidation/Extension

As a class, discuss each group’s observations. What did they think would occur vs. what occurred with each activity?

What could the students have done differently when building their house? Is there something that builders in northern communities should consider when constructing in these areas?

In order to finish consolidating the activity, have students answer the questions that are included in the handout.

Accommodations/Modifications

- Can be done outside
- Students may be given more time to create their house plan as well as build their structure according to their needs.
- Font on handout can be modified to be larger or a different colour according to visual needs.

Assessment

The handout can be collected and utilized as an Assessment **for** Learning to evaluate how well students have understood the lesson’s content and if they require anymore clarification. Furthermore, it can be used as an Assessment **of** Learning if you wish to evaluate your students in a summative manner.

References

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