

Goodness Gracious, Where Have All the Glaciers Gone?

Subject

Earth and Human Activity

Objectives

The students will:

- Understand the meaning and components of climate change
- Engineer and model how greenhouse gasses cause heat trapping

Materials

You will need outdoor space and a sunny day for the following activity:

- Open White Board Space
- 1 ice cube as a control and 1 additional ice cube per group, ~10
- Engineering kits (one per group):
 - Scissors
 - Scotch tape
 - Cotton balls (x8)
 - Paper plate
 - Popsicle Sticks (x8)
 - Index Cards (x2)
 - 4" x 4" fabric piece
 - Marker
 - 1-gal zip lock bag
- Clipboards for each student
- Glacier Melt Work Sheet
- Official Request from Nooksack Salmon Enhancement Association, with model identification card printed on backside.

Size/Setting/Duration

Entire class/classroom and outdoor space/~1 hour

Background

Climate change is a term used to define global or regional climate patterns, in particular a change largely attributed to the increase in atmospheric **carbon dioxide** produced by the use of fossil fuels (oil, natural gas, coal, etc.). **Fossil fuels** are **nonrenewable resources**, or resources that cannot be replaced once they are used, and is the most common energy resources used by people to power phones, cars, buildings, etc. **Renewable** resources also exist and are often "cleaner" than nonrenewable resources. These include wind, solar, and hydro power. Renewable resources tend to be "clean" because they are reusable, whereas nonrenewable resources are utilized via the burning of fossil fuels that cannot be re-burned to create more energy.

Sunlight reaching the Earth can heat the land, ocean, and atmosphere. Some of that sunlight is reflected back to space by the surface, clouds, or ice. Much of the sunlight that reaches Earth is absorbed and warms the planet. Burning fossil fuels emits carbon dioxide in the air. Carbon dioxide is important for the Earth because it traps the sun's warmth and allows life on Earth to flourish. However, as our population grows, we are burning more fossil fuels and producing more carbon dioxide, which acts as a heat trapping blanket, causing warmer temperatures than ever recorded and odd weather patterns.

A **glacier** is a slowly moving mass of ice known as 'rivers of ice' that is formed by the accumulation and compaction of snow on mountains. The North Cascades are home to over 300 glaciers and countless snow fields. Glaciers in the North Cascades melt to form rivers that will empty into the sea, including the Nooksack River! However, due to climate change glaciers are melting faster and some are vanishing due to wetter winters with less snowpack and drier summers with high heat. Less snow pack means high flows in the winter and spring and low flows that dry up in the summer and fall.

Procedure

1. Begin the lesson by presenting the phenomenon:

Did you know that the North Cascades, which surround Mt. Baker, has the most glaciers of anywhere else in lower 48 states? However, glaciologists, people who study glaciers, have noticed that these glaciers are melting. As scientists who live close to so many glaciers, the Nooksack Salmon Enhancement Association (NSEA) has asked for your help in determining why the melting is happening! Read the official request to students out loud.

We will be designing an experiment using ice cubes. Each ice cube will represent a different glacier in the North Cascades. There will be one ice cube without any influence (our control). It is your mission to use a collection of materials to melt your team's ice cube faster than the control. By seeing what influences might be melting the glaciers, NSEA hopes that you can explain why the beautiful glaciers in the North Cascades are melting.

2. Explain to students that they will be working in pairs to design their models and will make observations every 15 minutes. Student will have to work with three limits on their designs:
 - a. Only the materials provided can be used to melt the ice.
 - b. The ice cube must lay flat on the outdoor surface, because glaciers are natural and only have the Earth under them, so the ice cube must be the same.
 - c. Students must be able to see their ice cube in order to make observations over time.
3. Break students into teams of two (~10 teams), and then split the class into two larger groups (group A and group B – approximately 5 teams in each group).
 - a. Utilizing two different types of surfaces in your outdoor space (i.e. grass vs concrete). Place group 1 on the non-natural surface (i.e. concrete) and group 2 on the natural surface (i.e. grass) without explicitly telling the students that you are strategically placing them on different surfaces.

- b. Each student should be given the Glacier Melt worksheet with a clipboard to record data.
 - c. Give each team the 'Official Request' from the Nooksack Salmon Enhancement Association so that they have all the directions in front of them in case they forget.
 - d. Have students utilize the backside of the "Official Request" to sketch their model, name their model, and identify group A or B. Have students display identification cards next their model.
 - e. If students have extra time during any part of the experiment they can begin answering questions 1 & 2 following the worksheet.
4. Allow students 15 minutes to design and construct their model.
5. Start timer. Hand out ice cubes. Students can place their ice cube in their design and make their first observation of both their own ice cube and the control ice cube on their worksheet. Students have 15 min to rotate to other models in their group, recording observations of models and ice cube changes on data sheet.
6. At 15 min on the timer, have students make their second observation of their own model and the control. Then have students switch to the opposite group and record observations of models and ice cube changes (group A looks at group B models, while group B looks at group A models).
7. At 30 min on the timer, have students return to their own model and record final observations about their own ice cube and the control ice cube.
8. Discuss as a class the following questions.
 - a. What did they notice about their models?
 - b. What was different about group A and group B?
 - c. How do surfaces impact the heat of their models?
9. Have students use this discussion to answer question 1 of the Glacier Melt Worksheet.
10. Bring students back into the classroom and show students this 2 minute [video on climate change](#) to familiarize students with the effects of burning fossil fuels and the idea of heat trapping.
 - a. Discuss video and the various aspects of climate change – such as carbon dioxide gasses that have a similar effect on glaciers as their models had on the ice cubes. Carbon dioxide is important for us as it has made the Earth warm enough to support life. However, human activity (such as burning fossil fuels) is causing great carbon dioxide emissions, which makes the "heat trapping blanket" around the Earth warmer. Scientists predict many negative effects as a result of these changes in temperature and people are already being affected.
 - i. What do these results tell us about glaciers, snow pack, and ice caps?
 - ii. Have students answer question 2 on Glacier Melt Worksheet on their own, then list ideas as a class that can help reduce the emission of carbon dioxide (e.g. reduce energy use by turning off lights when you leave a room). Encourage students to go home and talk to their family about these opportunities.

Next Generation Science Standards

Performance Expectation		
4-ESS3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.		
Scientific and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<ul style="list-style-type: none"> Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information Developing and using models 	<ul style="list-style-type: none"> ESS3.A: Natural Resources ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change 	<ul style="list-style-type: none"> Cause and Effect System and system models

NGSS Lead States. 2013. [Next Generation Science Standards: For States, By States](#). Washington, DC: The National Academies Press.

Extension Resources:

Local Mt. Baker Glacier Study - <https://glacierchange.wordpress.com/tag/mount-baker-glacier-retreat/>

Media links for WA State glacier recession - <https://glacierchange.wordpress.com/2018/04/15/north-cascade-glacier-climate-project-media-links/>

Bellingham Herald Article - <https://www.bellinghamherald.com/news/local/article32632344.html>

Nooksack Tribe Report - https://cpb-us-e1.wpmucdn.com/blogs.uoregon.edu/dist/c/389/files/2010/11/Nooksack_Rivers-and-Glaciers_Profile_7-24-2014-2cpunfl.pdf



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Dear Whatcom County Fourth Graders,

The North Cascades surround Mt. Baker and are home to the greatest population of glaciers in United States after Alaska. However, the glaciers are melting and we worry that we will lose the glaciers in our own backyards if something is not done. Before we can do something about it, we need to know why they are melting. As scientists, your mission is to construct a model that will help explain why our glaciers are disappearing.

You will have 15 minutes to construct a model that will melt ice. The ice will represent the glaciers in the North Cascades. You will compare your melting ice to an ice cube with no influence (the control) and make observations about how fast the ice is melting and why. BUT you have some restrictions:

1. The ice must be touching the ground at all times. Glaciers form on mountains. In order to best represent a glacier, the ice you are melting must also not leave the ground.
2. You must be able to see the ice cube so that you can make observations throughout the course of this experiment.
3. You must only use the engineering kits provided by your teacher. Giving you a limited amount of supplies will help isolate what is happening to each glacier. You are not required to use all the material, but must not use anything additional.

Thank you for taking on this mission. We eagerly await your report.

Good luck!

Nooksack Salmon Enhancement Association

Sketch your model

Fold along dotted line

Name your model

Group letter

Glacier Melt Work Sheet

Use the table and graph below to record your results.

Time	Control Observations	Melting Model Observations
0 min		
15 min		
30 min		

Observations of other models

Group letter	Name of Model	Observations

1. What are some ideas you have for why glaciers are melting? How are the models helping us figure this out?
2. What are some actions we can take to help?