

Consequences of Melting Glaciers

Driving Question: How will climate change affect human habitats?

Synopsis: In this activity, students will learn how the melting of glaciers will increase sea level and cause the ocean to move farther and farther on land.

Rationale: This activity will explain how the melting of glaciers, not sea ice will cause sea level rise and how this will impact their beaches.

Materials: 1 glass bowl
Tape
Ice cubes
Water
A flat rock

Source: Quoted and adapted from SEED's Sea Ice and Glaciers

(<http://www.seed.slb.com/labcontent.aspx?id=33530&terms=sea+ice+and+glaciers>)

Transition: Now that we know how climate change can impact our health, what features of climate change could impact where we live?

Procedure

ENGAGE & INFORM

1. Ask the students what is the impact of climate change on the Earth's ice?
2. Explain the following while showing the images included at the end of the lesson:
 - Global warming is causing a reduction in the amount of ice on the Earth
 - The world's glaciers—the large masses of snow and ice found in the high mountains and on land in very cold parts of the Earth—are retreating, especially the massive ice packs of Greenland and Antarctica.
 - Arctic sea ice—the cap of ice that covers the Arctic Sea at the North Pole year-round—is in decline.

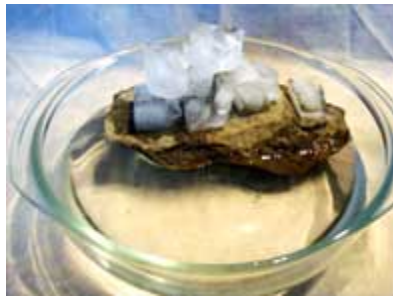
EXPLORE

1. Explain that although the melting of glaciers and sea ice is startling, only one of these phenomena results in rising sea levels. Today we will do an experiment to help you see which one will cause coastal flooding and which one will not.
2. Have the students write down a hypothesis on how the melting of each (glaciers or sea ice) will impact sea level rise and why.
3. Part 1: Sea Ice
 - a) Put some water in the bowl and add some ice cubes. You can put as much ice in as you want, but make sure it is all floating and not resting on the bottom. This is your Arctic Ocean with sea ice floating on it.
 - b) Mark the water level with a piece of tape.
 - c) Wait until the ice melts and check the water level and write down how it has changed?



4. Part 2: Glaciers

- a) Put a flat rock in the bowl and add water. The top of the rock should be a bit above the water level. The rock is your landmass, like Greenland.
- b) Place some ice cubes on top of the rock. The ice is your glacier.
- c) Again mark the water level with a piece of tape. Wait for the ice to melt. One or more ice cubes may fall into the water. This simulates the edges of glaciers breaking off and falling into the sea, a process called “calving.” This is a normal part of glacial melting.
- d) After all the ice has melted, what happens to the water level?



5. Ask the students to discuss their results and come to a conclusion as to whether the sea ice or the glaciers will contribute to sea level rise.
6. Ask the students whether their hypothesis was correct.

EXPLAIN

1. Explain the following:
 - Why does the melting of glaciers cause a rise in sea level while melting sea ice does not? The glaciers are on land, not in the ocean. When they melt, water is added to the ocean. When icebergs break off the edges of a glacier, they fall into the ocean. This is like adding ice to a glass of water.
 - You might point out that floating ice sits partly above the water, and when it melts, the part that was above sea level is now in the ocean. This is true, but it still does not add to the volume of water in the ocean. The reason has to do with a unique property of water. Ice is less dense than water. That’s why it floats. However, 90% of a floating block of ice sits below the waterline. Only 10% is above the waterline (show the picture of the sea ice).

- When floating ice melts, the water that results occupies 90% of the space that the ice did—exactly the portion of the volume of the ice that was below water. The water level does not change.
 - This applies to icebergs that calve off glaciers as well. When this type of iceberg falls into the ocean, it raises the sea level, because mass is being added to the ocean. But the melting of this iceberg causes no further change in sea level.
2. Explain that sea level rise may also be due to ocean warming due to increased temperatures. As water warms, it expands.

APPLY

1. Ask the student how change in sea level impact humans? Would it impact where they live or visit or where their parents work? How?
2. The following can be done if there is extra time, as homework, or as an extra project:
 - a) Have the students look at a map of NJ and determine how far they are from the coast?
 - b) Give/show them the map of how quickly sea level is changing around NJ (see below)
 - c) Have them determine the current average of sea level change around NJ
 - d) Then using their distance from the shore determine how long it will take before the ocean reaches them. Explain that there may not be enough snow and ice melting for this to actually happen.



View of Sea Ice if you could see it throughout the water column. (Image by Uwe Kils and Wiska Bodo, reproduced under Creative Commons license)



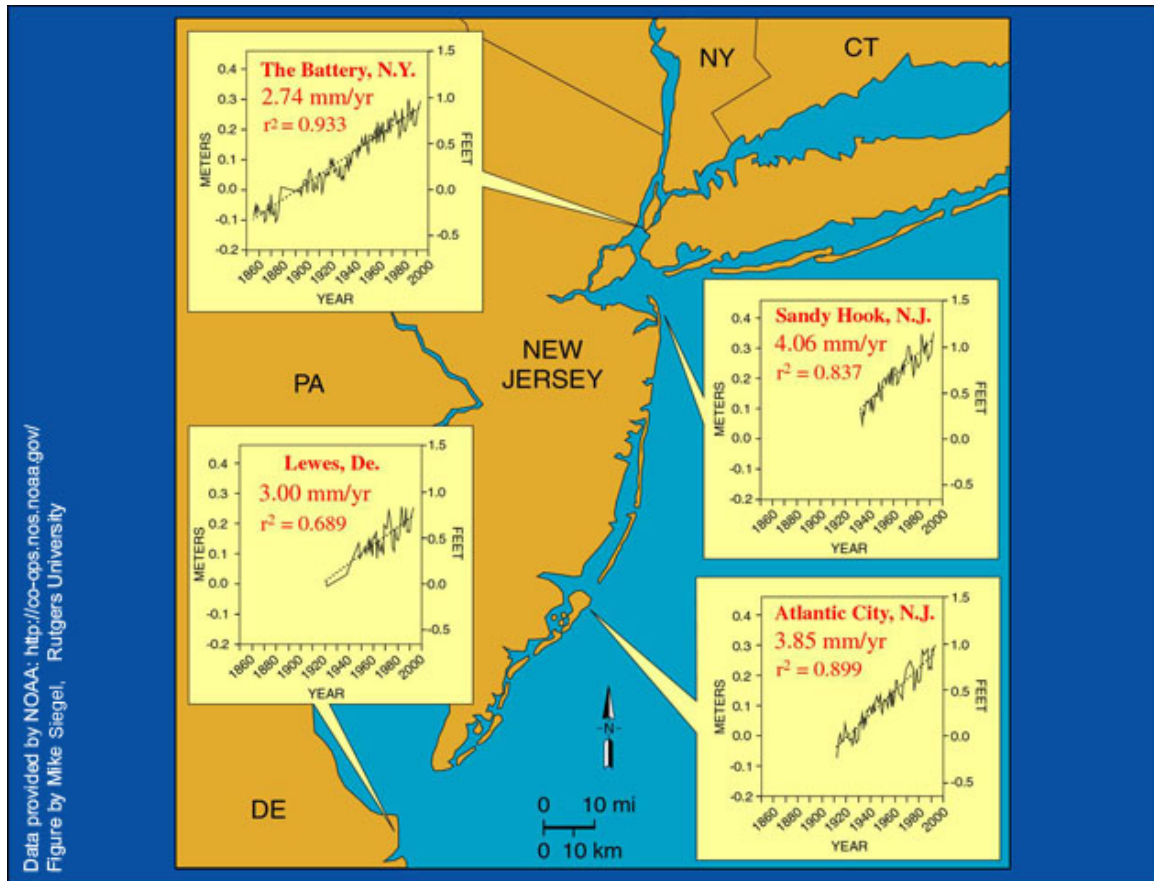
Greenland is covered in ice and snow.
(<http://www.seed.slb.com/labcontent.aspx?id=33530&terms=sea+ice+and+glaciers>)



The front of a melting glacier. (Image ID: corp2420, NOAA At The End of the Earth Collection; Photographer: Giuseppe Zibordi; Credit: Michael Van Woert, NOAA NESDIS, ORA)



Sea ice is an important platform for many polar marine vertebrates. Polar bears use sea ice for migration and hunting. Bears are also excellent swimmer, and dive for several minutes at a time. (Image courtesy of Arctic Exploration 2002, Rolf Grading, NOAA/OER.)



Data provided by NOAA: <http://co-ops.nos.noaa.gov/>
 Figure by Mike Siegel, Rutgers University

http://climatechange.rutgers.edu/images/nj_sl_rise_map.jpg