

STEAM Subject: Marine Science/Climate Science

Lab: Melting Polar Ice Caps

Grades: 4-8

Learning Objective:

Students will be able to:

- Distinguish the difference between arctic land and sea ice
- Model the effect of warming ocean and air temperatures on sea ice and explore the effects on marine life

ENGAGE:

Ask students the following questions:

- Look at the picture of the Earth. What covers most of the Earth? How much is covered by ice?



Image: NASA

- Do you think that most of the ice in the world is on land or floating in the ocean?
- How do you think an increase in temperatures can affect the ice on Earth?

EXPLORE:

Key Concepts:

- The Earth is known as the Goldilocks Planet: it is neither too hot nor too cold, and this favorable temperature allows life to exist
- Climate change has a number of detrimental impacts to the earth, one of which is melting ice and consequential sea level rise.

Melting ice cap activity:

Students will participate in an interactive activity where they observe the effects of warming ocean temperatures on ice melting, and measure sea level rise over time.

Materials Needed: (Option to do activity with just one tub instead of two)

- 4 large “icebergs” (water frozen ahead of time in a plastic bag or bowl, option to dye the water blue)
- 2 containers/tubs
- Stones
- Polar animals (figures, drawings, pictures, etc.)
- Ruler with centimeters
- Optional: Blue food coloring

Set up:

Fill up two tubs with a small amount of water. One tub will have room temperature water, while the other will have warm/hot water. Place rocks on one side to represent land.

Image credit:

<https://www.science-sparks.com/melting-polar-ice-caps/>



Directions:

Students can place the icebergs in their tub, and then place polar animals on the icebergs and land. Have students measure the height of the ocean water in centimeters at the start, and then every 20 minutes afterwards until the ice has completely melted (if time allows).

EXPLAIN:

What happened in our experiment?

Over time, we can see how, as the ice melted, the sea level rose above the level of the land, and there was less space for the animals on the ice. Also, the ice in the warm ocean water melted much faster than the ice in the room temperature water. If blue food coloring was used in the ice bergs, the blue has now mixed in with the clear ocean water. This shows us that with climate change and ocean warming, we can expect polar ice to melt much faster!

Ten percent of land area on Earth is covered with glacial ice, including glaciers, ice caps, and the ice sheets of Greenland and Antarctica. Glacierized areas cover over 15 million square kilometers (5.8 million square miles). Glaciers store about 69 percent of the world's fresh water.

Intro to polar ice:

- At the North and South pole of our planet are vast amounts of ice; this ice can come in three different forms.
- Ice caps: a thick layer of snow and ice covering less than 50,000 square kilometers. Ice caps form when snow falls, melts, and falls again. This happens again and again until all the layers form a huge mass of solid ice forms known as a glacier. This ice is made up of fresh water.
- Ice sheets: glacial ice caps that cover more than 50,000 square kilometers. Ice sheets form when snow that falls in winter doesn't entirely melt in the summer. Over time the snow accumulates and compresses to form ice sheets.
 - The Antarctic ice sheet is the largest single mass of ice on Earth.
 - How many meters do you think the sea would rise if this all melted? 60 meters!
 - Sea ice: frozen salt water that forms in the ocean, floating on top of the water. Sea ice is vital to polar animals, who use it to hunt and travel. Melting sea ice does not contribute to sea level rise, however it does pose a threat to the animals who rely on it.



Climate Change

- What is climate change?

Climate change is the change of regional and global climate patterns due to an increase in carbon dioxide from human activity

- What are some of the impacts of climate change on our world?

Sea level rise, ice melting, more frequent and extreme wildfires, hurricanes, and drought events, etc.

- Why are glaciers melting?
 - Glaciers have been melting since the beginning of the 19th century.
 - Scientists think this is because of human activities, especially the burning of fossil fuels which has increased the amount of carbon dioxide in the atmosphere leading to global warming.
- What are the effects of melting ice?
 - Usually, ice reflects the warmth from the sun back into space, like a mirror reflects light. This happens because the ice is pure white.
 - As ice melts, though, there is less warmth reflected, and the ocean water begins to absorb the warmth instead.
 - This contributes to the increasing temperature of our planet, which causes more ice to melt—this is called a positive feedback loop.

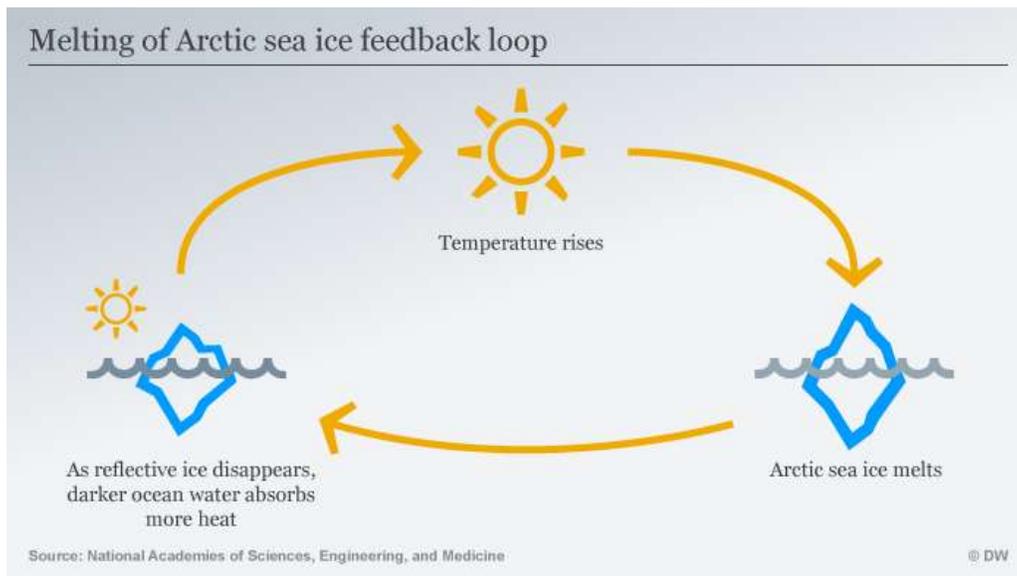


Image credit: <https://www.dw.com/en/when-nature-harms-itself-five-scary-climate-feedback-loops/a-43649814>

- Sea level rise
 - Land ice, such as ice caps and ice sheets, causes more sea level rise than sea ice because sea ice is already taking up volume in the ocean.
- Fresh water from melting ice sheets can also change ocean currents.
 - Ocean currents are controlled by several factors, a big one being the salinity of the water.
 - Salty water sinks to the bottom (since it is denser) and fresh water floats on top.

- When ice melts, it inputs more fresh water into the ocean, which can disrupt the currents and stop circulation all together. This can be very bad for ocean animals and extreme weather patterns.
- Lastly, ice melting can majorly affect the lives of animals that live, hunt, and travel on the ice (such as polar bears, penguins, walruses, and seals).
 - Learn more about polar animals: <https://oceantoday.noaa.gov/fullmoon-animalsoftheice/welcome.html>
 - Learn more about the impacts of melting polar ice: <https://oceantoday.noaa.gov/fullmoon-shrinkingice/welcome.html>

Review STEAM Vocabulary:

- **Climate change**: a change in global or regional climate patterns, attributed largely to an increase in atmosphere carbon dioxide as a result of fossil fuel usage
- **Ice cap**: a thick layer of snow and ice covering less than 50,000 square kilometers
- **Ice sheet**: glacial ice covering more than 50,000 square kilometers
- **Sea ice**: frozen salt water
- **Ice field**: an expanse of ice caps and glaciers.
- **Ocean current**: a permanent and continuous movement of ocean water that flows in one of the Earth's oceans. Currents are directed by wind, temperature, and salinity.
- **Positive feedback loop**: this occurs when the product of a reaction leads to an increase in that reaction (i.e. ice melting causes more warming which causes more ice to melt).

ELABORATE:

- Watch videos about the impacts of melting ice:
 - What If All The Ice Melted On Earth?: https://www.youtube.com/watch?v=b6CPsGanO_U
 - Time-Lapse Of the Disappearing Arctic Polar Ice Cap: <https://www.youtube.com/watch?v=2MhcPvX7enA>
- Let's look at the amount of ice melting in REAL TIME...
 - https://www.theworldcounts.com/counters/why_is_climate_change_important/melting_ice_caps_facts
- Select a topic to see how climate change has affected glaciers, sea ice, and continental ice sheets worldwide
 - <https://climate.nasa.gov/interactives/global-ice-viewer/#/>

EVALUATE:

Have students think of things that they can do to help alleviate carbon dioxide emissions in their own life.

RESOURCES:

https://www.science-sparks.com/melting-polar-ice-caps/?utm_medium=social&utm_source=pinterest&utm_campaign=tailwind_tribes&utm_content=tribes&utm_term=760264076_31209472_200888

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