PolarTREC Lesson Resource

How to Melt a Glacier

Sarah Slack

Thwaites Offshore Research

PolarTREC Expedition Page
https://www.polartrec.com/expeditions/thwaites-offshore-research

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Overview

This lesson will provide students with an opportunity to design and carry out an experiment that mimics the conditions causing accelerated ice melt along the face of the Thwaites Glacier off the southwest coast of Antarctica. Created by Sarah Slack during her expedition to Thwaites aboard the icebreaker Nathaniel B. Palmer, this activity aligns with the Science and Engineering practices of giving students the opportunity to develop their own investigations and to communicate their results. It can be completed either at school or at home using materials that most families will have on hand.

Objectives

At the end of this lesson, students will be able to:

- Design and carry out an investigation to test the rate at which ice melts in air vs. water
- Analyze why the results of their investigation are applicable to Thwaites Glacier, or to the Arctic or Antarctic cryosphere
- Communicate why melting ice is impactful for people in their community

Lesson Preparation

The Laws of Thermodynamics explain that ice will melt more rapidly in water than in air, but students won't need a deep understanding of thermal properties in order to design an experiment to test this situation themselves. Teachers will need ice and (ideally) enough space in a refrigerator to let that ice melt in either air or in water. They will also need a way to quantify the change in size of an ice cube over time. If students have access to a ruler or (better yet) a kitchen scale at home, this experiment would be easy to conduct remotely. The video, "Antarctica Melting" provides an excellent introduction to the situation at Thwaites Glacier in Antarctica, but you might have to work with your students to understand the ways in which melting glaciers will impact communities around the world- especially coastal communities in low-lying areas.

Procedure

1. Watch "Antarctica Melting: Journey to the Doomsday Glacier" on YouTube-

Resource Details

Date

1 September 2020

Region

Antarctic

Completion Time

About 1 period

Grade

Elementary and Up

Permission

Download and Share

Location

Thwaites Glacier, Amundsen Sea, Antarctica

Expeditions

Thwaites Offshore Research

Author(s)

Sarah Slack

Related Members

Sarah Slack

Frank Nitsche

Materials

Ice cubes of a relatively uniform size

Two small plastic dishes

Water

A refrigerator

A measuring device, such as a precise scale, a ruler, or calipers

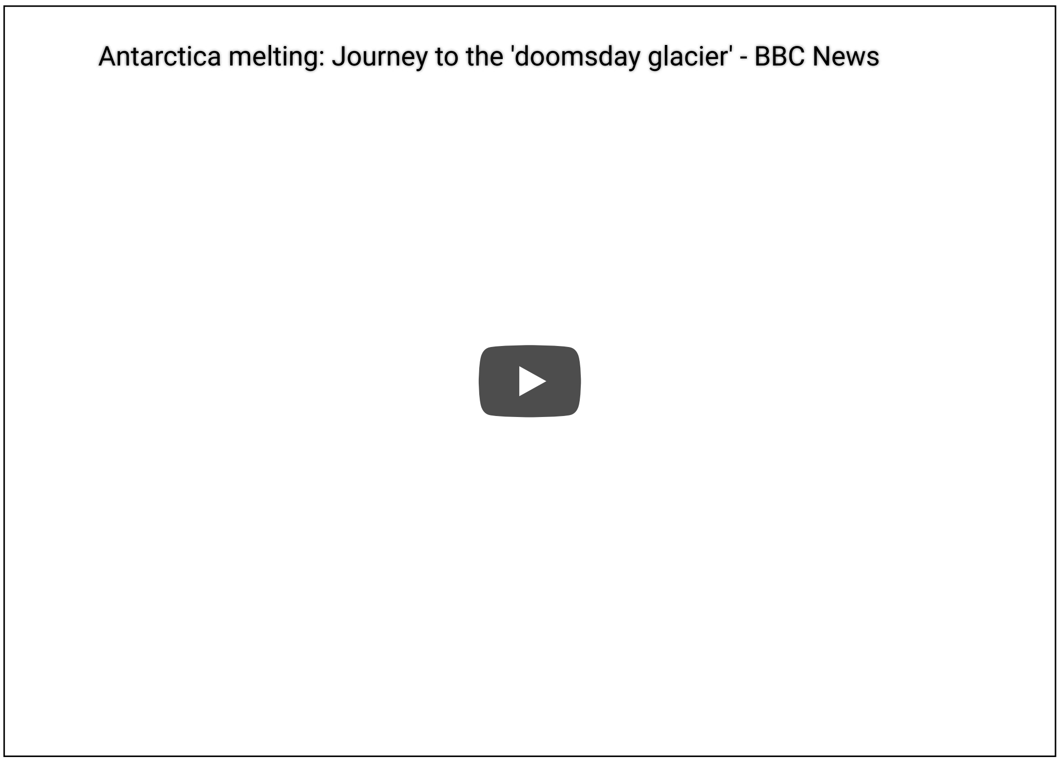
Pencil and paper

Topic

Climate Change

Oceanography

Water Cycle, Weather, and Climate



2. Discuss: why does it matter (to us here, to people everywhere) if an Antarctic glacier melts? What factors affect the rate at which the glacier melts?
3. Share this infographic of the structure of the Thwaites Glacier (https://www.carbonbrief.org/the-carbon-brief-interview-prof-jonathan-ba…). Thwaites is particularly vulnerable to melting because warm water is able to breach the grounding line and flow downslope at the bottom edge of the glacier.
4. Challenge students to design an experiment that will show whether water melts more rapidly when exposed to air or water at the same temperature. How can they investigate which factor- warming air or warming ocean water- is having a greater impact on the stability of Thwaites Glacier?

Although there are many possible ways to focus in on an answer to our experimental question, an ideal experiment should have one ice cube resting in a pool of water, and a similar ice cube in the air that is the same temperature as that water. Students should have a way to quantify any change in the size of the ice cube over time- either by measuring with a ruler or taking the mass. Setting up the experiment to run in a refrigerator does a better job of mimicking conditions at the poles. Students could be asked to critique or carry out the experiments designed by their peers.

Extension

This relatively simple activity allows students to see one factor affecting the melt rate of glaciers. Using the same types of materials, they could also investigate whether large or small ice cubes melt more rapidly (in terms of losing a percentage of their starting size), whether multiple ice cubes in the same container change the melting rate, or if the ice cube melts differently in salt vs. freshwater. More advanced students could conduct research into the Circumpolar Deep Water and how this current is affecting the stability of Thwaites Glacier and of the entire West Antarctic ice sheet.

Transferability

This activity, because it involves relatively low-tech materials, could easily be conducted at home. However, it does require some wait time (to allow the ice to melt) and therefore would not be appropriate for a short-duration informal education program.

Assessment

Students should be assessed on the quality of the lab activity they design. This can be done by either using the attached rubric or through a process of peer review (which should include having other students conduct the experiment as written).

Author/Credits

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Science Inquiry Rubric

4= 100% I did more than what was expected	**3=87%** I met the expectations.	**2=73%** I met some of the expectations.	**1=60%** I didn't meet most of the expectations.
My Focus During Science: • I followed all directions. • I effectively use my time to complete the activities and investigations. • I don't distract or get distracted by other scientists.	**My Focus During Science:** • I followed directions most of the time. • Most of the time I effectively use my time to complete the activities and investigations. • I don't distract or get distracted by other scientists.	**My Focus During Science:** • I followed directions some of the time. • I did not complete the design of an investigation • I distracted or was distracted by other scientists	**My Focus During Science:** • I followed directions after many reminders or didn't follow directions. • I didn't complete the activity • I distracted or was distracted by other scientists.
Scientific Thinking: • I can explain how I used my background knowledge and previous findings to design my experiment • I can thoroughly explain how the data/results/observations support my conclusions. • I make connections to previous learning or situations where similar things happened. • I generate new questions to investigate. • When I write or talk about science, I regularly and accurately use scientific vocabulary	**Scientific Thinking:** • I use my background knowledge and previous findings to design my experiment • I analyze the results to draw accurate conclusions. • I make connections to previous learning. • I generate new questions to investigate. • When I write or talk about science, I accurately use science vocabulary.	**Scientific Thinking:** • My experiment wasn't supported by any background knowledge or previous learning. I'm guessing. • I'm not collecting accurate data/observations. • I draw conclusions that aren't supported by my data or my conclusions aren't accurate. • I can make connections to previous learning with some help. • I am focused on answering the question at hand without generating new questions. • I occasionally use scientific vocabulary	**Scientific Thinking:** • I didn't design an experiment before investigating. • I do the steps of the investigation without collecting data, making observations, and drawing conclusions. • I don't use what I learned from previous investigations. • If a problem arises during an investigation, I get stuck. • I'm not using science vocabulary
Working with Lab Partner: • Our conversation is focused on the topic it should be. • I build on my partner's ideas instead of just taking turns sharing. • I use evidence to support my ideas. • I give my partner feedback to help them see other ideas. • I use my partner's feedback to set goals and push my scientific thinking. • I use scientific vocabulary accurately in our conversations.	**Working with Lab Partner:** • Our conversation is focused on the topic it should be. • I build on my partner's ideas instead of just taking turns sharing. • I use evidence to support my ideas. • I use scientific vocabulary accurately in our conversations.	**Working with Lab Partner:** • Sometimes our conversation is focused on the topic it should be. • We take turns sharing instead of building on each other's ideas. • I don't have evidence to support my ideas. • I use scientific vocabulary in our conversations, but not always accurately.	**Working with Lab Partner:** • I am not talking about what I should be. • We take turns sharing instead of building on each other's ideas. • I didn't support my ideas using evidence. • I don't use scientific vocabulary.

How Warm Ocean Water can Cause the "Grounding Line" to Retreat