



TEACHERS AND RESEARCHERS EXPLORING AND COLLABORATING

PolarTREC Lesson Resource

Sinking Water

Sarah Slack

Thwaites Offshore Research

PolarTREC Expedition Page

<https://www.polartrec.com/expeditions/thwaites-offshore-research>



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Overview

This lesson about the factors affecting water density in the Amundsen Sea was developed by educator Sarah Slack during her PolarTREC expedition aboard the Nathaniel B. Palmer icebreaker. Part of the science mission was to create a detailed map of the seafloor at the face of the Thwaites Glacier, which revealed a series of channels that were conducting a current of slightly warmer water (known as the Circumpolar Deep Water or CDW) up to the grounding line of the glacier. Since warmer water is less dense than colder water, it seems counterintuitive that the CDW would sink, so there has to be another factor involved. Based on an experiment described on the Exploratorium website, this activity will challenge students to determine what causes the CDW to sink.

Objectives

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

- Explain how different samples of water can have different densities (temperature, salinity).
- Communicate why water density matters in the circumpolar environment.
- Modify an inference as a result of data and observations.

Lesson Preparation

This starts off as an easy experiment requiring only basic supplies - you will need two identical clear jars, a few index cards, two different colors of food coloring, some very cold water, and some pretty hot water. If you invert a jar of very cold blue water on top of a jar of very hot red water and then remove the barrier between them, the cold water (which has a greater density) sinks into the jar of warm water, causing the two colors to mix. If you reverse the jar position and invert the hot red water over the cold blue water and remove the barrier, nothing happens. The hot water is less dense than the cold water so it floats on top. While this is a fun experiment for students to try themselves, that requires making a lot of hot red water and cold blue water and will definitely result in a lot of spilling. It might be best to use this as a demonstration in class but be sure to practice the technique of sealing the bottle with an index card before you invert it in front of your students. Density differences caused by water temperature does not explain why, along the southwest coast of Antarctica, the warmer waters of the Circumpolar Deep Water are leading to accelerated melting from the underside of the Thwaites and Pine Island Glaciers. In order for students to understand why the CDW sinks, they will need to conduct the same experiment, but this time vary the salinity of the two different-colored water samples.

Resource Details

Date

25 September 2020

Region

Antarctic

Completion Time

Less than 1 period

Grade

All Aged

Permission

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Location

Thwaites Glacier, Amundsen Sea, Antarctica

Expeditions

Thwaites Offshore Research

Author(s)

Sarah Slack

Related Members

Sarah Slack

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Materials

Two colors of food coloring (red and blue are used as examples)

Two identical clear bottles (Snapple bottles work well)

Very cold water

Very hot water

A bin to catch water spills

Procedure

- Before you begin, students should have an introductory understanding of density and the relationship between temperature and density.
- The procedure for this experiment is clearly described on the [Exploratorium website](#). Hot water is less dense and it floats on top of cold water, cold water is denser and will sink in hot water.
- Next, show students the recent [BBC article](#) that describes how researchers have identified channels in the seafloor in front of Thwaites Glacier that direct the Circumpolar Deep Water current up to the grounding line of the glacier and are causing accelerated melting. The CDW is slightly warmer than the rest of the water in the Amundsen Sea- why does it sink?
- Try a similar experiment, this time using same-temperature water but vary the salinity. Which type of water (freshwater vs. saltwater) is denser?

Extension

With younger students, this demonstration of different densities and accompanying explanation of what happened could constitute the extent of the lesson. With more advanced students, it could provide a jumping-off point to explore the global movement of ocean water and how that affects climate around the world.

Transferability

Since it helps to have both very hot and very cold water when doing this as either an experiment or a demonstration, it follows that it would be useful to have access to a refrigerator and a microwave oven or heat source. Students (either in formal or informal settings) could conduct this as an experiment, but there will be a lot of spilled water- it is best done outside, over a bin, or directly in the sink.

Resources

- The Exploratorium website: https://www.exploratorium.edu/science_explorer/watertrick.html
- Circumpolar Deep Water: <http://www.antarcticglaciers.org/glaciers-and-climate/ice-ocean-interac...>
- The impact of CDW on Thwaites Glacier: <https://www.bbc.com/news/science-environment-54079587>
- PolarTREC educator Sarah Slack's blog post about this experiment: <https://www.polartrec.com/expeditions/thwaites-offshore-research/journa...>

Author/Credit:

Adapted from "The Amazing Water Trick" on Exploratorium.com by Sarah Slack, 2019 PolarTREC Teacher
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