When Water Gets Icy

Ask A Biologist activity for classroom and home

By Kyle Kinzler

Table of Contents

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When Water Gets Icy
http://askabiologist.asu.edu/when-water-gets-icy

Frozen Life
http://askabiologist.asu.edu/explore/frozen-life

About the Author

Kyle Kinzler is a graduate student at Arizona State University and is working on his Masters thesis focusing on Arctic sea ice algae with Dr. Susanne Neuer.

Experiment Overview

If you've accidentally taken a sip of sea water or had to gargle with salt water, you've probably realized that freshwater and saltwater have some pretty important differences. These differences exist not only when these waters are liquid, but also when they freeze. In this experiment, we will look at one major difference between frozen freshwater and frozen saltwater.

What you need

- Table salt
- Water (tap water is fine)
- Transparent container, for example a clear water bottle with the top cut off or a drinking cup (x2)
- Food Dye (any color will work)
- Measuring cup
- Measuring spoon (teaspoon)
- Tape and marker for labeling

Before You Begin

As you read in the Frozen Life companion story, when sea ice forms, freshwater freezes and leaves behind a concentrated salt solution called brine. This brine is found in pockets throughout the ice. Brine pockets allow organisms that get trapped in the ice to avoid freezing and survive until the next spring. The pockets are small and isolated in winter, but in spring, as the ice begins to warm, the brine pockets get bigger and combine with other pockets to form channels which allow the organisms to move throughout the ice. You can explore the differences in channels between seasons in our channel maze.

In this experiment we are going to compare the difference between regular freshwater ice (the kind you would put in your drink) and sea ice. To do this we will create fresh and saltwater ice, then put a couple drops of dye on each type of ice and compare what happens. What do you think is going to happen? Do you think the dye will act the same in both ice types?

This should ideally be done over two days. The first four steps in the Procedure should be done on Day 1, and the remaining steps should be completed on Day 2.

Procedure (1-4 should be done ahead of time)

Step 1: Measure out two cups of water into each of your two containers (you can use less if your container is too small). Make sure to leave a little room as the water will expand when it freezes.

Step 2: Using your tape and marker, label one container "water" and the other "salt water."

Step 3: In your "salt water" container, dissolve 1.5 teaspoons of salt for every cup of water (so, if you have two cups, use 3 teaspoons).

Step 4: Put the containers in a freezer (this will take at few hours to freeze, best done overnight) and keep frozen until ready to perform experiment

Step 5: Take the ice out of the containers and set them next to each other. These are going to melt and make a mess so put the containers on a tray or a sink.

Step 6: Add 5 drops of dye to the top of the freshwater ice and note what happens. (If nothing seems to happen, you can add a few more drops of dye.)

Step 7: Add 5 drops of dye to the top of the saltwater ice and note what happens.

For Teachers

Tips for Classroom Implementation

Time Required: Two 50-minute class periods on two different days (one to prepare and freeze the ice cores, the other to add food coloring and observe its movement through or around the ice).

Classroom set-up

- Zoom Gallery Option: Reserve the computer lab for this day. Each pair of students will need a computer so they can access the Plankton Zoom Gallery. Students should be supplied with a couple pieces of white printer paper and a pencil with an eraser.
- Plankton Collection Option: Students will need access to pond water (a nearby pond where you can collect as a class, or it can be supplied by the teacher). Each pair of students will need a microscope to view the plankton. Students should be supplied with a couple pieces of white printer paper and a pencil with an eraser.

Tips

- Read Frozen Life companion story as a class before beginning this activity. It will teach students about brine channels in sea ice and the importance of plankton in arctic ecosystems.
- Place a container under the ice to collect water as it melts.

Extensions

- Conduct experiment with many different concentrations of salt to see how the dispersion differs between ice samples.
- Research and observe how long it takes for water with different concentration of salt to freeze. At 32˚F (0˚C) the fresh water will freeze but with salt water it will not freeze at this temperature.
- Research and observe the effects of temperature on ice. Have students touch both types of ice (before adding food coloring) and see if they can feel a difference. The salt water ice will feel colder because when

salt is added to water it lowers the freezing point. Water will continue to get colder until it reaches its freezing point (depending on the salt concentration, typical sea water at 34ppt salinity would freeze at 28.65˚F (-1.86˚C)) so it will be colder than fresh water.

Objectives

1. Students will compare and contrast the differences between sea and freshwater ice.

Standards

Arizona Science Standards

Strand 1: Inquiry Process

Concept 1: Observations, Questions, and Hypotheses

K-4: Observe, ask questions, and make predictions.

Strand 1: Inquiry Process

Concept 2: Scientific Testing (Investigating and Modeling)

K-4: Participate in planning and conducting investigations, and recording data.

Strand 4: Life Science

Concept 3: Organisms and Environments

K-4: Understand the relationships among various organisms and their environment.

Common Core Standards

Grades: 6-8.RST.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Next Generation Science Standards

5-LS2-1.

- Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. (For this one, have students walk through the food webs in the Frozen Life companion story.)