# Can sea water freeze?

By Anne Tweed with Heather Hein

A demonstration of the use of inquiry in a middle-school science classroom, this 45-minute lesson is part of a four-lesson unit on salinity patterns and the water cycle which asks and answers the question, "Can sea water freeze?" This activity shows how the salinity of sea water changes the freezing point of water.

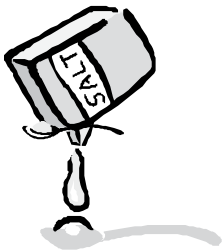
**Objective:** To learn about the unique properties of sea water, specifically that its freezing point is slightly lower than that for fresh water and that oceans do not freeze (except in extreme polar areas) because of the salinity.

**Standards Addressed:** Grades 5–8 NSES Physical Science Standard 1

- Understands properties and changes of properties in matter

**Materials Needed:**

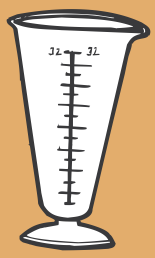
- Two plastic beakers or similar containers
- Crushed ice
- Two unfrozen "freeze pops"
- Measuring cup
- Thermometer
- Graph paper
- Rock salt
- Balance




**Procedure:**

1. In a teacher-directed use of inquiry, start by asking students a question that makes the topic (the salinity and freezing points of water) relevant to the students. E.g., if it's winter, ask *why do they put salt on icy roads?* If you live near the ocean, ask *do oceans freeze? Why or why not?*
2. In small groups, students obtain two large beakers (1000 or 500 ml) and fill them with equal weights of ice, about $^{2}/_{3}$ full. Label the beakers A and B.

## Ideas for extending this lesson



### *Changing the freezing point of water*

"Salt content changes the freezing point of water" is the first of three lessons included in the Salinity Patterns and the Water Cycle unit found at http://aquarius.nasa.gov/sea_water_freeze.php. The other two lessons examine the effects of salinity on formation and buoyancy of sea ice.

### *Effects of salinity on the freezing rate*

In two 45-minute class periods, students mix varying amounts of salt with water and put the mixtures in ice cube trays in a freezer. Then, they record water temperatures and conditions of the water after one hour, 24 hours, and 48 hours.

### *Buoyancy*

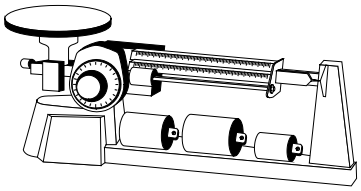
In one 45-minute class period, students take the ice cubes from the previous experiment and float them in beakers filled with water of the same water-salt mixtures to test and record how well each kind of ice floats in each solution.

3. Place a thermometer in each beaker and record the temperature of the ice. Students should take their temperature measurement once the ice has stabilized or after they've added it to the beaker (not during).
4. Mix 230 grams of rock salt with the ice in Beaker A. When adding the salt, make sure it's distributed evenly throughout the beaker and not piled on top of the ice.
5. Insert one freeze pop into the center of each beaker.
6. Record the temperatures in each of the beakers every 5 minutes for a total of 30 minutes. Graph temperature versus time for Beaker A and Beaker B.
7. Fifteen minutes into the experiment, pour another 115 grams of salt into Beaker A.
8. Twenty-five minutes into the experiment, pour another 115 grams of salt into Beaker A.
9. Examine the freeze pops at the end of the experiment and determine which one has frozen and its degree of hardness. Record the results.

**Questions/Assessment:**

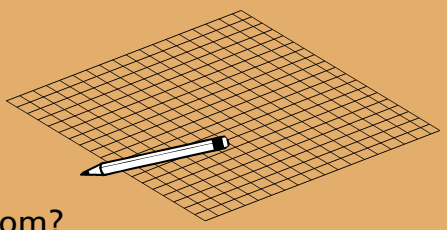
- Why did the salt-ice mixture produce a lower temperature than the ice without salt?
- Why do oceans freeze at a much lower temperature than bodies of fresh water? CS

Adapted originally from the Salt Institute activity, "Salt: The Essence of Life," and revised by McREL's Anne Tweed, this is one of many inquiry-based lesson plans designed to teach students about NASA's 2009 Aquarius mission to study global sea surface salinity. Find this and the other activities of "Can Sea Water Freeze?" at http://aquarius.nasa.gov/sea_water_freeze.php



## Inquiring minds want to know

*Essential questions are open-ended and do not have obvious "right" answers. They directly relate to a unit's key concepts. Here are some essential questions for a unit on salinity patterns and the water cycle:*



- What happens to water when it freezes?
- How is salt used in our everyday lives?
- Why don't the oceans freeze?
- If oceans don't freeze, where do icebergs come from?
- Are icebergs salty? Is sea ice salty?
- Will an object float in saltwater and freshwater in the same way?