

General Science 181 Laboratory

Freezing Temperature Of Ocean Water

During winter in the Northern Hemisphere, Arctic air temperatures often dip below what we normally think of as the freezing point of water. Yet, while freshwater lakes freeze over, much of the ocean stays in liquid form rather than freezing into ice. Why doesn't ocean water freeze at the same temperature as fresh water?

In this experiment, you will use a Temperature Probe to measure the temperature of water as it cools and then freezes. In Part I, you will collect temperature data as you freeze fresh water and determine its freezing temperature. In Part II you do the same for ocean water. You will then compare the two freezing temperatures and hypothesize why they are different.

OBJECTIVES

In this experiment, you will

- Observe the freezing of fresh water and ocean water.
- Use a Temperature Probe to measure temperature.
- Determine the freezing temperature of fresh and ocean water.

MATERIALS

computer
Vernier computer interface
Logger Pro
Temperature Probe
test tube
400 mL beaker

ring stand (one clamp and a rod)
salt
Ice
plastic spoon
fresh water
ocean water

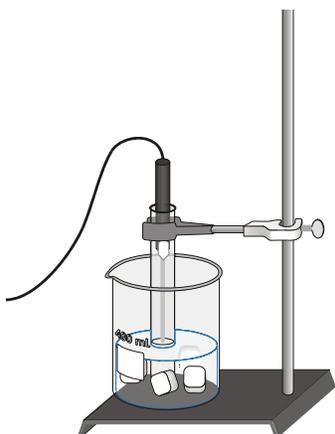


Figure 1

PRE-LAB QUESTIONS

1. Predict at what temperature fresh water will freeze.

_____ °C

2. Predict at what temperature ocean water will freeze.

_____ °C

PROCEDURE

Part I Freezing Fresh Water

1. Plug the Temperature Probe into DIN 1 of the Vernier computer interface box.
2. Click on Logger Pro (2.2.1).
3. Prepare the computer for data collection by opening the file “17 Freezing Ocean Water” from the *Earth Science with Computers* folder. Choose Exp 17 Direct Connect Temp. A temperature vs. time graph will show on the screen.
4. Fill a 400 mL beaker 1/2 full with ice from the ice chest at the back of the lab. Then add enough water to cover the ice from the sink in the storeroom through the door at the back of the lab. Add 5 spoonfuls of table salt and 5 spoonfuls of rock salt to the beaker and stir with a plastic spoon. Leave the spoon inside for later stirring.
5. Now put about 5 mL of distilled water into the small test tube (about one thumb width amount in the tube). Then use a utility clamp to fasten the test tube to a metal rod. See fig. 1. Be careful not to crush or drop the tube while setting it up. You must keep the test tube above the salty ice-water bath for now. Place the Temperature Probe into the water **inside the test tube**.
6. When everything is ready, click  to begin data collection. Then lower the test tube into the ice-water bath.
7. Soon after lowering the test tube, stir the fresh water sample in the test tube gently with the temperature probe. **DO NOT REMOVE THE PROBE FROM THE WATER.** Continue to stir the salty ice-water bath with the spoon.
8. Slightly, but continuously, move the probe during the first 10 minutes of data collection. Be careful to keep the probe in, and not above, the ice as it forms. When 10 minutes have gone by, stop moving the probe and allow it to freeze into the ice. Continue to stir the ice-water bath. Add more ice cubes as the original ice cubes get smaller.
9. Make and record observations as the water freezes.

10. When 15 minutes have passed, data collection will stop.
11. On the displayed graph, analyze the flat part of the curve to determine the freezing temperature of fresh water by doing the following.
 - a. Move the mouse pointer to the beginning of the graph's flat part. Press the mouse button and hold it down as you drag across the flat part to *select* it.
 - b. Click on the Stat (Statistics) button, , above the graph. The mean temperature value for the selected flat part is listed in the statistics box on the graph. This is your value for the freezing temperature of fresh water. Record it in your data table.
12. Click on Print Window from the File menu to print out this graph for later analysis. Print one copy for each person in the group.
13. **Do not attempt to remove the Temperature Probe from the ice!** Remove the probe from DIN 1. Put the test tube with the probe stayed in under the faucet in the storeroom to melt the ice, then remove the Temperature Probe. Pour out the water.

Part II Freezing Ocean Water

14. Repeat Steps 5–10, and 12 using ocean water in the test tube instead of distilled water. You may find that you need to add more ice and salt to the ice-water bath to freeze the ocean water.
15. Print out copies of this graph for later analysis (one for each person in the group). Label one of your graphs “Fresh Water” and one “Ocean Water”.
16. Label the regions of each graph where the water is entirely in liquid form.
17. Show the super cooled regions on both graphs.
18. Show the freezing point on each graph.
19. Show the phase change region on both graphs.
20. Show the region where all water has changed to ice

OBSERVATIONS

Part I Freezing Fresh Water

Part II Freezing Ocean Water

DATA TABLE

	Part I Fresh Water	Part II Ocean Water
Freezing Temperature (°C)		

QUESTIONS

1. What was happening to the water during the flat portion of each graph?
2. Based on your data, which type of water has to get colder in order to freeze, fresh water or ocean water?
3. In some areas, icy roads are “salted” to make them safer for drivers. Use your data to explain why this is an effective method.