

How Low Can You Go?

In this experiment, you will use an EasyTemp temperature probe to find the normal melting temperature of ice. Then by adding salt to melting ice, you will see the effect of salt on the melting temperature of ice. You will next make and test a plan for reaching the coldest temperature using water, ice, and salt. Finally, you will have a contest to see which group can make their mixture reach the lowest temperature.

OBJECTIVES

In this experiment, you will

- Use an EasyTemp probe to measure temperature.
- Find the normal melting temperature of ice.
- See the effect of adding salt on ice's melting temperature.
- Plan and test an experiment to find the salt and ice combination that will make the coldest temperature.
- Compete with other groups trying to reach the coldest temperature.
- Apply the results of the experiment.

MATERIALS

TI-84 Plus or TI-84 Plus Silver Edition
graphing calculator
Vernier EasyTemp
Vernier EasyData application

crushed ice
salt
balance
250 mL beaker



Figure 1

PROCEDURE

Part I The Melting Temperature of Ice

1. Turn on your TI-84 Plus (or TI-84 Plus Silver Edition) graphing calculator and make sure that it is on the home screen. Plug the EasyTemp probe into the USB port of the graphing calculator. The EasyData application will automatically start and the Main screen will be displayed.
2. Set up the data collection.
 - a. Select $\overline{\text{F1}}$ from the Main screen, and then select **New**.
 - b. Select $\overline{\text{SETUP}}$ from the Main screen.
 - c. Select **Time Graph....**
 - d. Select $\overline{\text{EDIT}}$.
 - e. Press $\overline{\text{CLEAR}}$ on the calculator and type **10** as the time between samples in seconds. Select $\overline{\text{NEXT}}$.
 - f. Press $\overline{\text{CLEAR}}$ on the calculator and type **60** as the number of samples. Select $\overline{\text{NEXT}}$. The length of the data collection will be 600 seconds (10 minutes).
 - g. Confirm that time graph settings are correct. Select $\overline{\text{OK}}$.
3. Put 100 mL of crushed ice into a 250 mL beaker.
4. Place the EasyTemp probe into the ice. Select $\overline{\text{START}}$ to begin data collection.
5. Hold the beaker in one hand and the EasyTemp probe with your other hand. Stir the ice until a steady temperature is reached. Record this temperature in your data table. It is the normal melting temperature of ice.

Part II The Effect of Salt on Ice's Melting Temperature

6. Add 5.0 grams of salt to the ice water and stir. Continue stirring until the temperature stops dropping.
7. Determine the lowest temperature reached.
 - a. When the temperature stops dropping, select $\overline{\text{STOP}}$ to end the data collection.
 - b. A graph of temperature vs. time will be displayed. Use $\overline{\text{D}}$ to examine the data points along the curve. As you move the cursor, the time (X) and temperature (Y) values of each data point are displayed above the graph.
 - c. Record the lowest temperature reached.
 - d. Select $\overline{\text{MAIN}}$ to return to the Main screen.

Part III Finding the "Coldest" Mixture

8. Make and test a plan for finding the coldest possible temperature using 5.0 grams of salt and the materials used in Parts I and II. Outline your plan in the Contest Plan section below.

Part IV The Coldest-Temperature Contest

9. Set up the equipment as in Part I.
10. Put the amounts of water and ice you found to be best in Step 8 into the 250 mL beaker.
Note: All student groups should do this part of the experiment at the same time.
11. Get 5 grams of salt from your teacher. Add this salt to the water and ice. Place the EasyTemp probe into the water, ice, and salt mixture and then select **START** to begin data collection.
12. Stir until your coldest temperature is reached, and then select **STOP** to end the data collection.
13. Examine your data and record the lowest temperature reached.
14. Select **Main** to return to the Main screen. Select **Quit** from the Main screen. Select **Off** to exit the EasyData application.

DATA

Normal melting temperature of ice	°C
Coldest salt and ice-water temperature (Part II)	°C

CONTEST PLAN**PROCESSING THE DATA**

1. How does the melting temperature of water (ice) compare with its freezing temperature?
Hint: See your results for Experiment 14, "Freezing Temperature of Water."
2. What is the effect of adding salt on ice's melting temperature?
3. If you had a chance to repeat the contest, what would you do differently?
4. List some uses for the ideas studied in this experiment.