



Ice Cream Lab

Linda Preston

Topic

Lowering the freezing point



Time

2½ hours (includes time required to chill the ice cream mixture before doing the experiment)



Safety

Please click on the safety icon to view the safety precautions. Do *not* use a mercury-filled thermometer.

Materials

For Each Pair of Students

Celsius thermometer
400-mL beaker, can, or bowl
3- to 5-oz paper cup
plastic spoon
stirring rod or stick
crushed ice
rock salt

For Preparation

wire whisk or electric beater
bowl large enough to hold mixture
1-gal milk container
refrigerator

The ingredients listed below will make enough ice cream mixture for 50 pairs of students to do this experiment as directed. You can quarter the mixture or use your own recipe for a smaller number. If you divide this recipe, use only ¼ tsp salt.

1 qt half-and-half
7 cups milk
2½ cups sugar

four eggs
1 tsp salt
3 tbs vanilla

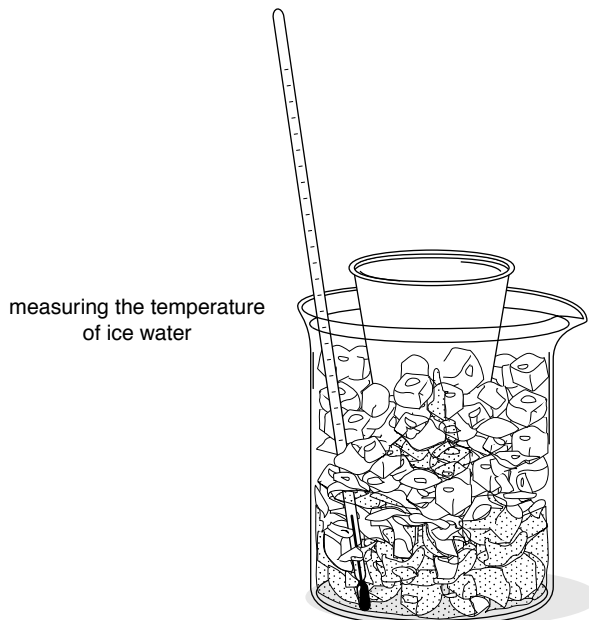
Procedure

PART A: PREPARATION

1. Make up the ice cream mixture using the ingredients above. Beat it until smooth.
2. Store the mixture in a 1-gal milk container. Chill for at least 2 hr, and keep chilled until ready for use.

PART B: MAKING THE ICE CREAM

1. Find a partner to work with you.
2. Layer crushed ice, some rock salt, and water in the 400-mL beaker. The mixture should be slushy in appearance. The beaker should be filled within 2 cm of its rim.
3. Carefully place the paper cup in the center of the beaker. You may want to double up two cups, one inside the other, to prevent leakage.
4. Fill the paper cup to within 1 cm of its rim with some of the ice cream mixture.
5. With a thermometer, check both the temperature of the ice cream mixture and the ice/salt mixture (see figure). Record the temperatures on the data table.
6. Have your partner stir the ice cream mixture with the plastic spoon while you stir the ice/salt slurry with the stirring rod or stick. Continue to add ice and salt as necessary.
7. Record temperatures every 5 min.
8. Continue the experiment until the ice cream mixture solidifies.



| DATA TABLE | | |
|-------------------|-------------------|------------------|
| Time (min) | Temperature (°C) | |
| | Ice cream mixture | Ice/salt mixture |
| 0 | | |
| 5 | | |
| 10 | | |
| 15 | | |
| 20 | | |
| 25 | | |

9. Why was it necessary to stir both mixtures?
10. Describe what you observed happening in the experiment.
11. Why did the ice cream mixture freeze solid when it was sitting in a liquid?
12. How can water be a liquid if the temperature is less than 0°C?

What's Going On

Both mixtures must be stirred in order to maintain a uniform temperature throughout. The ice cream mixture freezes solid after approximately 20 min. The temperature outside the paper cup was well below 0°C, the freezing point of water. The temperature of the ice cream mixture was close to 0°C. The ice cream froze because the surrounding liquid lowered the temperature to the mixture's freezing point. The freezing point of water was lowered because of the addition of salt. In general, the freezing point of the solution (in this case salt and water) is lower than that of a pure solvent (water). The particles of the solute (salt) fill up the spaces between the water molecules

Connections

The *freezing point* is the temperature at which a liquid solidifies. Molecular activity has come to a near standstill when this occurs. You can lower the freezing point of a substance. In this demonstration, you learned how while making ice cream.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say “be careful with hot liquids” or “don’t cut yourself with the knife” does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don’t use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES