Quick Freeze

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Topic

Freezing point depression

Time

1 day preparation; 1 hour to completion

Safety

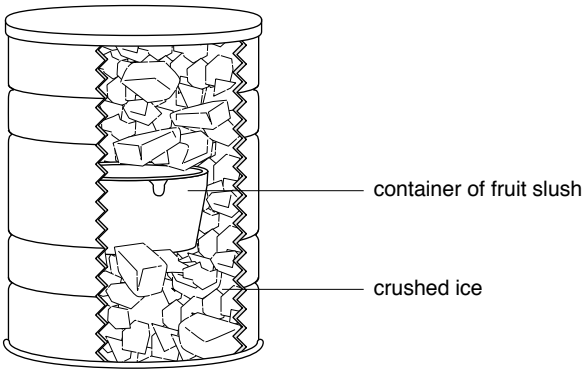
Please click on the safety icon to view the safety precautions.
Wear gloves when rolling the can to protect your hands.

Materials

two snack slushes, such as Wyler's Fruit Slushes™
rock salt
hammer
13-oz coffee can with plastic lid
dish towel
two identical ice cube trays
outdoor thermometer
water
gloves
freezer
watch or clock

Procedure

1. Fill the ice cube trays, and put them in the freezer overnight to harden.
2. Take out one of the frozen trays and wrap 10 cubes of ice in a dish towel. With the hammer, break up the ice inside the towel into small chips.
3. Put about half the crushed ice in the coffee can, and put a Fruit Slush™ container on top of it. Put the rest of the ice in on top. Close the can. Now you have the setup pictured in the figure.



Cutaway view showing interior of coffee can.

4. Put on your gloves.
5. Roll the can back and forth for 15 min.
6. Open the can, and remove and rinse the Fruit Slush™ container.
7. Put the thermometer in the ice water in the can and record its temperature here: _____
8. Open up the Fruit Slush™ and note whether or not it is frozen. Put the thermometer in the Fruit Slush™ and record its temperature here: _____
9. Repeat steps 2 and 3, this time adding 6 tbs rock salt to the ice in the coffee can.
10. Repeat steps 4 through 7. Note the temperature of the ice water here: _____
11. Rinse off the slush container and open it up. Note whether or not it is frozen. Rinse off the thermometer thoroughly and put it in the slush. Note its temperature here: _____
12. Eat the slush if you would like to.
13. Dispose of the salt/ice mixture in your basement sink.
14. Which Fruit Slush™ froze more completely in 15 min, the one in plain ice water or the one in salt–ice water?
15. Which liquid had the coldest temperature, fresh ice water or salt–ice water?
16. Does adding salt to water raise or lower the freezing point of the solution?
17. Why doesn't the Fruit Slush™ freeze at 0°C?
18. Does the Fruit Slush™ mixture have a higher or lower freezing point than salt–ice water? How do you know?

What's Going On

The second slush—the one in the salt–icewater solution—froze completely in 15 min. The first one did not freeze much at all. Salt–ice water was colder than regular ice water. Adding salt lowers water's freezing point. The Fruit Slush™ doesn't freeze at 0°C because it, too, is a mixture with a lowered freezing point. The Fruit Slush™ mixture has a higher freezing point than saltwater. It froze while the salt–ice water was still liquid at the same, or a lower, temperature.

Connections

Water with any amount of ice in it always remains at the same temperature—0°C (32°F)—the freezing point of water. Dissolving a substance like sugar or salt in water will change its freezing point. In this experiment you saw what happens to the freezing point of water when you added salt.

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