Everyone Scream for Ice Cream

Food Demonstration

Introduction

Everyone loves ice cream! Take an in-school field trip to the cafeteria, gym or even outside, and discover the scientific principles that are important in making our favorite summertime dessert. Use food-grade materials from home and household zipper-lock bags. When the freezing point depression demonstration is over, it's time to eat!

Concepts

- Freezing point depression
- Colloids

Materials

Milk, whole, 1 cup
Rock salt, NaCl, ½ cup (about 140 g)
Sugar, ¼ cup (from a grocery store)
Vanilla extract, ½ tsp
Ice, ½ gallon
Water
Cups, 2
Gloves or mittens (optional)
Resealable bag, 1 qt size
Resealable bag, 1 gal size
Sink or basin
Spoons, 2
Thermometer

Safety Precautions

Food products brought into a laboratory should be treated as laboratory chemicals and not consumed. Perform this activity in a sanitary environment that does not contain laboratory chemicals such as a cafeteria. The salt–ice water mixture will get very cold and may become too cold to handle—wear gloves or mittens or use a towel.

Procedure

1. Place the milk, vanilla, and sugar in the small resealable bag. Try to remove as much air as possible from the bag before sealing it. Mix the contents by shaking and kneading the bag without breaking it open.
2. Check that the bag is well-sealed, then place it inside the large resealable bag.
3. Place about one-half gallon of ice into the large resealable bag, and add about one-half cup of rock salt to the ice. Seal the large bag.
4. Gently roll, knead or toss the bags for 10–15 minutes. As the large bag gets cold, hold it by the corners or wear gloves. Take care not break the bag open.
5. After 10–15 minutes, place the large bag in a sink or basin. Carefully open the bag and remove the smaller bag.
6. (Optional) Record the temperature of the salt–ice water mixture.
7. If the ice cream in the small bag is solid, proceed on to step 8. If the ice cream is not solid, place it back into the salt–ice water mixture and continue cooling as in step 4. Additional salt or ice may have to be added.
8. Rinse the saltwater off the outside of the ice cream bag.
9. Transfer the ice cream to cups and enjoy.

Disposal

The saltwater and ice cream ingredients may be disposed of down the drain.

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NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School
MS-PS1 Matter and Its Interactions
PS1.A: Structure and Properties of Matter
PS1.B: Chemical Reactions
Disciplinary Core Ideas: High School
HS-PS1 Matter and Its Interactions
PS1.A: Structure and Properties of Matter
PS1.B: Chemical Reactions

Science and Engineering Practices
Planning and carrying out investigations
Constructing explanations and designing solutions

Crosscutting Concepts
Cause and effect
Structure and function
Stability and change

Tips

- The salt–ice water mixture must be well agitated to evenly distribute the sugar and flavors in the ice cream and also to facilitate the cooling process. The salt–water mixture has a temperature lower than pure ice. The freezing point depression of sodium chloride is substantial and it is not uncommon to reach temperatures of –15 °C.
- Additional ingredients such as fruit syrups or preserves, chocolate chips or syrup, or crushed cookies may also be added along with the sugar and vanilla.
- Substituting half & half, whipping cream, or heavy cream for the milk will make the ice cream thicker and tastier but also add to the calorie content.
- Some teachers use dry ice or liquid nitrogen to make ice cream. These materials greatly speed up the process but are more expensive and increase the risk of frostbite.
- Have students calculate the approximate molality of the saltwater solution and the theoretical freezing point depression for the salt–ice water mixture.

Discussion

For people who want to combine a love of science with a love of food, food science offers exciting opportunities. A tremendous amount of science is necessary for the preparation of our modern-day convenience foods. Chemical principles play a vital role as food scientists seek ways to improve the taste and safety of foods and to keep food fresh longer.

Ice cream is a frozen (solid) foam consisting of air mixed in a solution of sugar, protein, and fat in water. The protein and fat molecules dispersed in the milk are very large particles and thus form a colloidal mixture rather than a true solution.

Ice cream will not form at 0 °C. In order to form ice cream, a temperature of about –10 °C is necessary. In this demonstration, the below-freezing temperature is obtained from a salt–ice water mixture that freezes at about –15 °C. Salt lowers the temperature of ice water because the freezing point of a solution is always lower than the freezing point of a pure solvent. When a solute, such as sodium chloride, dissolves in a solvent, such as water, it lowers the temperature at which the solution freezes. The amount that the freezing point is reduced is called the freezing point depression, and it depends on the concentration of the solute, the number of solute particles formed, and the properties of the solvent.

Materials for *Everyone Scream for Ice Cream* are available from Flinn Scientific, Inc.

Catalog No.	Description
S0065	Sodium chloride, Laboratory Grade (Rock salt, coarse), 1 kg
AB1004	Bags, zipper-lock, 6″ × 12″
AB1005	Bags, zipper-lock, 12″ × 15″

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.