

Science in-a-Bag

A Chilling Experience: Ice Cream and Changes in State

(Jim Kreuger, Program Consultant, KSO)



Introduction

What better way to teach some science than to combine it with something that we already enjoy... eating? And when the menu is ice cream you can be sure that even the most finicky student will be interested. This activity allows each student to make their own delicious ice cream and learn some basic science to boot.

Materials (per student)

1 large zip-lock bag

1 small or medium zip-lock bag

1 cup of milk

2-3 spoons of sugar (to taste)

1 capfull of vanilla

2 trays of ice or equivalent amount

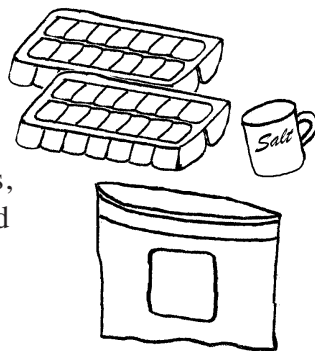
one quarter cup of salt

spoon

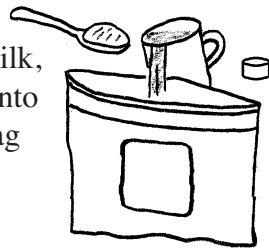
straw (optional)

Instructions

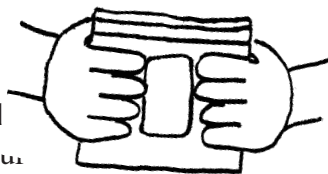
1 Into a large zip-lock bag, place 2 trays of ice cubes, or equivalent in crushed ice, and add the salt.



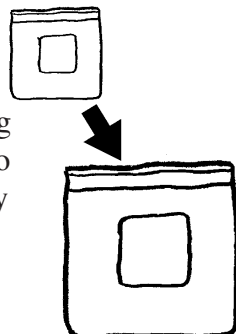
2 Measure out the milk, sugar and vanilla into a small zip-lock bag and remove the air by flattening the sides and sealing the bag.



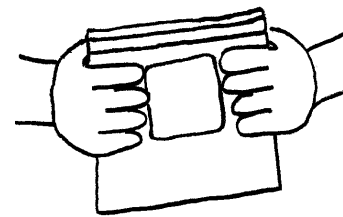
3 Squeeze bag gently in hands until sugar has dissolved into milk mixture.



4 Place the small bag (milk mixture) into the large bag (salty ice), expell the air and seal the bag.



5 Distribute the ice mixture to surround the inner bag making sure that its seal remains up-right. Using gloves or mitts gently squeeze the bags.



6 Ice cream should be ready in about 10-15 minutes and may be eaten from the bag with a spoon.

Suggestions

Lake ice may be used but must be broken into small pieces before placing it in the bag. This ice tends to be more jagged and care must be taken not to puncture the bag during the mixing process. The large zip-lock bags are reusable, but for health reasons the small bags should be discarded. Milk shake flavourings and syrups offer variety to the classic vanilla.

How it Works

Water begins to freeze and become ice at 0°C. This makes ice an excellent substance for cooling beverages. However, when ice is placed into a drink, it does not freeze the drink, it merely cools it to a temperature slightly above 0°C. This means that ice alone is not cold enough to turn a milk mixture into ice cream. Adding salt to ice lowers the melting point of ice (freezing point of water), in other words, it makes ice colder. This salt and ice mixture happens to be cold enough to make ice cream. Heat moves from high concentrations to low concentrations. The heat from the milk mixture (and the students hands) moves to the ice mixture and melts it. This loss of heat from the milk (and hands) results in a drop in temperature, that is, they get colder. This continues until the water in the milk freezes and the ice cream becomes solid.

Technically, ice cream is not a solid but a frozen foamy mixture of four distinct states: solid fat globules, air bubbles, ice crystals and a solution of sugar, flavourings and milk particles. Squeezing the bags is essential during the freezing process to attain this desired mixture. Squeezing prevents the ingredients from separating, mixes in air and allows the water in the milk to freeze as tiny crystals rather than as one large solid lump. Besides calories, the fat particles give ice cream its smooth creamy qualities.

Follow-Up and Discussion

Making ice cream in class with this simple method will be a definite hit with your students but you should not overlook the excellent opportunity it presents to teach some science. This activity may be used to introduce topics like: states of matter, phase changes (changes in state), mixtures/solutions and, in high school, freezing point depression. It may also be used to wrap up these same topics. Some student inquiries that follow naturally from this investigation are:

- ★ Freezing Point Depression: Comparison of the temperatures of ice solutions containing differing amounts of salt.
- ★ The Effect of Agitation During the Freezing Process on Ice Crystal Size: What would happen if a bag of milk mixture was frozen in a freezer with out agitation or squeezing? Have students compare it to their own product.
- ★ The Effect of Milk Fat on Ice Cream Quality: What is the difference between ice creams made with skim milk, 2% milk, homo milk and half & half. Have students make these different varieties and determine which is best.
- ★ Can Yogurt be Used to Make an Ice Cream-Like Dessert? Have students try this activity with yogurt instead of milk. Better yet have them make the yogurt first then turn it into frozen yogurt.

Besides being fun, delicious and interesting, this activity has a great ripple effect through your school and community. Students will naturally want to show their friends and family what they have learned and this gives the parents of your students a window on your classroom and the view they get will be a positive one.

