Ice Cream Experiment

Materials

- Half and half
- Soymilk*
- Ice
- Sugar
- Vanilla extract
- Rock salt
- Tablespoon
- Large (gallon) ziplock bags
- Smaller (quart) ziplock bags
- Measuring cup

Instructions

1. Mix together 1/2 cup of half & half (or ½ cup of soymilk), one tablespoon of sugar, and 1/4 tablespoon of vanilla extract in the smaller quart-sized ziplock bag. Seal the bag shut.
2. Fill the larger gallon-sized ziplock about 1/3 full with ice. Add 1/3 cup of rock salt to the ice.
3. Place the small half & half bag inside the ice-filled bag. Seal the ice-filled bag.
4. Now shake and "massage" the bags for about ten minutes.
5. When you have finished, empty the contents into a bowl and enjoy!

*Use instead of half&half in case of lactose intolerance

Ice Cream Chemistry: Tutor's Guide

Notes

This is a great activity to do as a group. Students can each make their own ice cream. If you wish to bring additional flavors or additions – feel free! Some things that might work well are chocolate powder or sauce, other extracts and flavors such as peppermint, or even toppings!

The lesson

1. Chat with students about favorite foods
2. Tell them you have a unique lesson today – making ice cream!
3. Do the experiment
4. While they are enjoying their ice cream, watch the video The Sci Guys: Science at Home - SE1 - EP10: Melting Points: Ice Cream in a Bag - 10 Minute Ice Cream
   https://www.youtube.com/watch?v=s1CpSrXa1EI
5. Ask follow up questions and discuss with students

The Science

If you would just put cream in the freezer, you would not end up with ice cream. Instead, you would simply have a block of hard-frozen, solid cream. The reason that ice cream as we know it has a soft and fluffy texture has to do with chemistry!

Ice has to absorb energy in order to melt or change from a solid to a liquid. When you use ice to cool the ingredients for ice cream, the energy is absorbed from the ingredients and from the outside environment (like your hands, if you are holding the baggie of ice!).

When you add salt to the ice, it lowers the freezing point of the ice, so even more energy has to be absorbed from the environment in order for the ice to melt. This makes the ice colder than it was before, which is how your ice cream freezes. Ideally, you would make your ice cream using 'ice cream salt', which is just salt sold as large crystals instead of the small crystals you see in table salt. The larger crystals take more time to dissolve in the water around the ice, which allows for even cooling of the ice cream.

You could use other types of salt instead of sodium chloride, but you couldn't substitute sugar for the salt because (a) sugar doesn't dissolve well in cold water and (b) sugar doesn't dissolve into multiple particles, like an ionic material such as salt. Compounds that break into two pieces upon dissolving, like NaCl breaks into Na^+ and Cl^-, are better at lowering the freezing point than substances that don't separate into particles because the added particles disrupt the ability of the water to form crystalline ice. The more particles there are, the greater the disruption and the greater the impact on particle-dependent properties (colligative properties) like freezing point depression, boiling point elevation, and osmotic pressure.

Follow-up Questions

* How are the characteristics of the liquid milk different from the solid ice cream?

* In order to change the liquid to solid, what had to happen?

* What happened to the heat energy that left the milk?

* What are the variables we could change in making ice cream?

* What ideas do you have for freezing the ice cream faster?

* Why did the outside of the bag get wet?

Sources:

http://mstlnaz.pbworks.com/f/Ice+Cream+In+A+Bag+Lesson+Plan.pdf

http://blogs.discovermagazine.com/science-sushi/2013/02/26/at-home-science-ice-cream-chemistry/#.WNwoPTsrJPZ

https://www.thoughtco.com/how-to-make-ice-cream-in-a-bag-602195