Have you ever made homemade ice cream? Not only is it a tasty and fun activity, but you can also learn a lot of interesting chemistry at the same time! For example, think about how the ingredients change during this process –how quickly does it take to change the final product? Does the starting temperature make a difference? How do certain added ingredients change the process? In this science activity, you'll make your own ice cream (in a bag!) and explore the best way to chill and make a delicious summer treat!

Objectives

- Learn about phases of matter
- Learn about freezing points
- Create new ice cream flavors and combinations!

Materials

- 1/2 cup half and half
- 1/4 tsp vanilla
- 1 Tbs sugar
- 3 cups ice
- 1/3 cup kosher or rock salt
- Gallon size zip top bag(s)
- Quart size zip top bag(s)
- Sprinkles, chocolate sauce, fruit (optional but really "the best part" ingredients!)

Introduction

To make ice cream, you will have to cool the ingredients down, until they convert from a liquid to a solid state. One way to create a super cold environment is to add salt to the ice. Salt lowers the temperature at which water freezes. Technically, the temperature that the salt lowers is called the freezing point. When a freezing point is lowered, such as by adding salt to the water, the process is called freezing-point depression.

Experimental Procedure

1. Gather Place the ice and the salt into the gallon size bag.
2. In the smaller bag, mix the half and half, vanilla, and sugar. Remove as much air as possible and seal the bag tightly. Double check the seal, just to be sure!
3. Place the smaller bag inside the gallon-sized bag. Shake the bags for about 5-10 minutes until your ice cream is solid. Use oven mitts or a towel to protect your hands from getting freezer burn!
4. Remove the small bag, wipe off the outside, and enjoy your scientific treat!

How Does It Work

When salt and ice mix, the freezing point of the ice is lowered. The more salt is added, the lower the temperature can get. For example, water will normally freeze at 32℉ (0℃). A 10% salt solution freezes at 20℉ (-7℃) and a 20% solution freezes at 2℉ (-17℃). By lowering the temperature at which ice freezes, you were able to create an environment in which the cream mixture could freeze at a temperature below 32℉ (0℃) and become ice cream. The shaking (or stirring in an ice cream maker) moves the warmer cream mixture from the inside to the outside of the bag so it can freeze evenly. That way you make a smoother product. Additionally, shaking introduces air which helps create a fluffier ice cream texture.

Research Questions

1. What happens when you add less salt? More? Does the type of salt change the ice cream formation time?
2. What happens if you swap out the milk for half-and-half?
3. Does the addition of special ingredients like cookies, sprinkles, or flavoring changes the freezing time? Does pre-cooling them help?
4. What happens if you only shake it a little bit? Does the texture change?

What is brain freeze?

Brain freeze, or ice cream headache, is the sensation of pain caused by rapid temperature changes in your mouth. When you take a big bite of cold ice cream, blood vessels in the roof of your mouth constrict to reduce blood flow and heat loss. After you swallow, the blood vessels quickly rewarm and dilate, increasing the blood flow and stimulating nearby pain receptors. Your brain then sends out pain signals along your trigeminal nerve, the largest cranial nerve, and you experience pain behind your eyes and across your forehead, your jaw, and the back of your head. To prevent this, just slow down. Savor ice cream slowly in small bites. Or, if you've already pressed a big, cold bite against the roof of your mouth and then swallowed it, drink something cool to slow down the rapid rewarming of your blood vessels.
(from Fine Cooking – the Science of Ice Cream)

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