**Making Ice Cream in the Lab**

**Materials**

* 1/2 cup milk
* 1/2 cup whipping cream (heavy cream)
* 1/4 cup sugar
* 1/4 teaspoon vanilla or vanilla flavoring ([vanillin](http://chemistry.about.com/library/graphics/blvanillin.htm))
* 1/2 to 3/4 cup sodium chloride (NaCl) as table salt or rock salt
* 2 cups ice
* 1-quart ZiplocTM bag
* 1-gallon ZiplocTM bag
* themometer
* measuring cups and spoons
* cups and spoons for eating your treat!

**Procedure**

1. Add 1/4 cup sugar, 1/2 cup milk, 1/2 cup whipping cream, and 1/4 teaspoon vanilla to the quart ziplocTM bag. Seal the bag securely.
2. Put 2 cups of ice into the gallon ziplocTM bag.
3. Use a thermometer to measure and record the temperature of the ice in the gallon bag.
4. Add 1/2 to 3/4 cup salt (sodium chloride) to the bag of ice.
5. Place the sealed quart bag inside the gallon bag of ice and salt. Seal the gallon bag securely.
6. Gently rock the gallon bag from side to side. It's best to hold it by the top seal or to have gloves or a cloth between the bag and your hands because the bag will be cold enough to damage your skin.
7. Continue to rock the bag for 10-15 minutes or until the contents of the quart bag have solidified into ice cream.
8. Open the gallon bag and use the thermometer to measure and record the temperature of the ice/salt mixture.
9. Remove the quart bag, open it, serve the contents into cups with spoons and ENJOY!

**Explanation**

Ice has to absorb energy in order to melt, changing the phase of water 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 depresssion](http://chemistry.about.com/od/solutionsmixtures/a/freezingpointde.htm), [boiling point elevation](http://chemistry.about.com/od/solutionsmixtures/a/boilingpointele.htm), and [osmotic pressure](http://chemistry.about.com/od/chemistryglossary/a/osmoticpressure.htm). The salt causes the ice to absorb more energy from the environment (becoming colder), so although it lowers the point at which water will re-freeze into ice, you can't add salt to very cold ice and expect it to freeze your ice cream or de-ice a snowy sidewalk (water has to be present!). This is why NaCl isn't used to de-ice sidewalks in areas that are very cold.