Ice Cream: Freezing-Point Depression and Liquid Nitrogen

**Objective**: We are going to make ice cream using two methods: freezing-point depression and liquid nitrogen.

# Estimated materials for 20 students:

1. 1 ½ quart of half-and-half
2. 1 quart heavy cream
3. 1 gallon of heavy cream
4. 6.5 quarts of sugar ~ 1.5 lbs
5. 21 lbs of ice
6. 20 quart ziplock bags
7. 20 gallon ziplock bags
8. eating utensils
9. container of imitation vanilla extract
10. roses
11. bananas
12. marshmallows
13. small magnet
14. metal dish
15. leather gloves for handling cryogens
16. 5 L liquid nitrogen
17. Lab coat
18. Balloons
19. Hammer
20. Random plant
21. Wooden spoon

# What is Ice Cream?

Milk (or cream), sugar, and flavorings that has been frozen in a way to give it a creamy texture.

# How to make Ice Cream?

## Freezing-point depression

Freezing-point depression introduction [video](https://www.youtube.com/watch?v=YglP2El_cqU).

Activity: [Make ice cream with rock salts](https://www.thoughtco.com/how-to-make-ice-cream-in-a-bag-602195)

### **Ice Cream in a Bag Materials**

* 1/2 Cup milk
* 1/2 Cup whipping cream (heavy cream)
* 1/4 Cup sugar
* 1/4 Teaspoon vanilla or vanilla flavoring (vanillin)
* 1/2 to 3/4 Cup sodium chloride (NaCl) as table salt or rock salt
* 2 Cups ice
* 1-Quart Ziploc bag or another zipper-top baggie
* 1-Gallon Ziploc bag or ​another zipper-top baggie
* Thermometer
* Measuring cups and spoons
* Cups and spoons for eating your treat!

### **Procedure**

1. Pair up. One student will make icecream without rock salts, the other one with rock salts.
2. Add 1/4 cup sugar, 1/2 cup milk, 1/2 cup whipping cream, and 1/4 teaspoon vanilla to the quart zipper bag. Seal the bag securely.
3. Put 2 cups of ice into the gallon plastic bag.
4. Use a thermometer to measure and record the temperature of the ice in the gallon bag.
5. One student will add 1/2 to 3/4 cup salt (sodium chloride) to the bag of ice.
6. Place the sealed quart bag inside the gallon bag of ice and salt. Seal the gallon bag securely.
7. 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.
8. Continue to rock the bag for 10-15 minutes or until the contents of the quart bag have solidified into ice cream.
9. Open the gallon bag and use the thermometer to measure and record the temperature of the ice/salt mixture. Compare with your partner.
10. Remove the quart bag and open it. Did you make ice cream? If so, share with your partner.

# Make Liquid Nitrogen Ice Cream

## Safety:

The liquid-to-gas expansion ratio of nitrogen is **1:694** at 20 °C (68 °F). [Asphyxiation](https://en.wikipedia.org/wiki/Asphyxia) can be a real threat if the room is too small or not well ventilated.

## Liquid Nitrogen demonstrations:

1. Watch vapors. See it boil in the container.
2. Dunk balloons. Watch it contract and expand.
3. Dunk a rose. Crush it.
4. Dunk a banana. Break it. (optional)
5. Dunk marshmallows. Eat them.
6. Spill liquid nitrogen on the floor. Leidenfrost effect. (after all, for wrap up)
7. Magnet levitation with YBCO puck in a styrofoam cup.

## [**Make Liquid Nitrogen Ice Cream**](https://www.foodrecipeshq.com/liquid-nitrogen-ice-cream-how-to/)

### **Ingredients**

* 1 ½ quart of half and half
* 1 quart of heavy cream
* 1 ½ cup sugar
* 5 tablespoons vanilla if you like vanilla ice cream or chocolate syrup, peaches, bananas, etc.

### **Instructions**

1. Mix the half and half, cream, sugar, vanilla, and other items in the large pot. Then pour in a small amount of liquid nitrogen. Continuously stir with the wooden spoon.
2. The only tricky part in making this ice cream is making sure you don’t put in liquid nitrogen too rapidly. If you do, the mixture will bubble up and expand out of the pot, making a big mess. Have one person pour in liquid nitrogen while another person stirs. Pour the liquid nitrogen in a little bit at a time until you get the hang of it. There will be a lot of water condensation so that you probably will not be able to see the bottom of the pot for the first few minutes.
3. Continue stirring and adding liquid nitrogen until the ice cream is as hard as you wish. Don’t let it clump.