

Ice Cream in a bag

Q: What can I do with all this leftover winter rock salt?

A: Make delicious ice cream in a bag, of course!



Experiment # 1

What You Need:

- 2/3 cup of half & half
- 2 4 oz. clear glasses, preferably with an usual shape
- 2/3 cup of sugar
- table or flat surface protected by a table cloth
- paper towels for clean up

What to tell your students:

T: Scientists tell us that a *solid is a material in which the atoms or molecules are in a fixed position and can only vibrate in place.*

- *What does that really mean?*
- *How can we test whether something is a liquid or a solid? One way for us to comprehend this concept is to understand that solids generally maintain their shape and have a definite volume.*
- *Then, what makes something a liquid? Liquids can assume the shape of their container and can be poured.*

T: *This test works sometimes – like with this half & half.*

Teacher pours cream into a glass and it assumes the shape of its container.

...but, what about with this sugar?

Teacher pours 1/2 cup of sugar into another glass and it seems to do the same thing.

What do you observe? (Allow students time to respond.)

T: *A better test might be – pouring the substance onto a flat surface*

Teacher pours some of the half & half onto a flat surface. Teacher pours the sugar onto flat surface.

What differences do you observe? (Allow students time to respond.)

...That's right – the cream went all over the place but the sugar formed a sort of lump – didn't it?

That is because the sugar is a solid; it is made up of tiny little solid particles but it's still a solid.

T: *Next we are going to change this liquid half & half into a solid.*

What might we have to do to accomplish that?

S: (Allow students time to respond.) Freeze it?

T: *Yes, that's exactly right. We are going to do the half & half one better, though. We are going to make it into ice cream. To do that, we do have to freeze it. But so we don't have to wait hours and hours for it to get cold enough to actually harden into ice cream, we are going to use a chemistry trick to freeze it much faster.*

What happens?

How does rock salt help us make ice cream? Salt mixed with ice causes the ice to melt. When salt comes into contact with ice, the freezing point of the ice is lowered. Water will normally freeze at 32 degrees F. A 10% salt solution freezes at 20 degrees F, and a 20% solution freezes at 2 degrees F. By lowering the freezing point of the ice by covering it with salt, the ice melts very quickly and we are able to create a super cold environment in which half and half can freeze fairly rapidly into ice cream.

Experiment # 2

What you need:

Per group of three

- 1 cup half & half
- 1/2 teaspoon vanilla
- 2 tablespoons sugar
- 4 cups crushed ice
- 1/2 cup rock salt
- 2 quart size zip-top plastic bags
- 1 gallon size zip-top freezer bag
- Mittens/gloves
- Measuring cups and spoons
- Small cups and spoons for serving the ice cream
- Thermometer
- A piece of wax paper

What to do:

1. Predict how cold your solution will be when your liquid mixture becomes ice cream and record your prediction.

2. Measure and mix the first three ingredients together into one quart-size zip-top bag. Squeeze out the air and seal the bag tightly. Place this bag inside a second quart-size bag, and seal it up tight.

3. Next, measure the ice and rock salt and put that into the gallon-size freezer bag.

4. Place the double-bagged ingredients inside the gallon-size freezer bag, squeeze out the air and seal it up tight.

5. **Now for the fun part:** Take turns gently shaking and kneading the bag, making sure the ice is evenly spread out. Use gloves or mittens to keep your hands from getting too cold. Keep shaking and kneading the bag until the mixture freezes.

6. After about 10-15 minutes when the ingredients seem frozen, use a thermometer to find the temperature of the melted ice in the big bag. Was your guess on the mark?

7. Use a spoon to take a little bit of ice cream out of the bag and put some onto the wax paper. Does it form a lump? Is it a solid?

8. Divide the ice cream into three small cups so everyone in your group can enjoy some!

What happens?

Making ice cream demonstrates changes in the state of matter. For example, the liquid matter (half & half mixture) turns into solid matter (ice-cream). As the liquid gets colder it expands. The molecules in the liquid slow down and eventually freeze in place. During the ice-cream making process, the ice also changes states from a solid into a liquid—water. When ice absorbs energy, it changes the phase of water from a solid to a liquid. The ice absorbs energy from the ice-cream ingredients and also a little bit from your hands as you hold the bag. The molecules start moving around again as the ice melts.

Questions to Consider:

We understand that salt + ice helped the liquid to freeze and become a solid faster but what else did you do during this experiment that helped the freezing process along?

The shaking and kneading helped circulate the ice around the half and half and kept the ice solution in closer contact with the half & half mixture. The closer the liquid mixture is to the ice, the easier it is for heat to transfer from the mixture to the ice and the faster the mixture will freeze.

Extension:

- *What do you think would happen if you used different amounts of salt or rock salt?*
- *How about different thicknesses of bags? Would your time to turn the ingredients into ice cream be greater or less?*
- *What if you didn't knead it or shake it?*
- *Choose a variable to test and investigate further.*



Additional Resources for Grades 5-12

Molecular model animation: http://preparatorychemistry.com/KMT_flash.htm
http://www.harcourtschool.com/activity/states_of_matter/index.html