

STEAM SUBJECT: Chemistry

Lab: Ice Cream Chemistry

Grades: 2-8

Learning Objective:

Students will be able to explain the freezing point of water (and make homemade ice cream!). Students will create a solution that will freeze an ice cream mixture.



Engage:

Ask the students the following questions:

- At what temperature does the liquid water freeze to become ice?
 - 0 degrees Celsius ($^{\circ}\text{C}$) or 32 degrees Fahrenheit ($^{\circ}\text{F}$). *However, scientists have found liquid water as cold as -40 degrees F in clouds and even cooled water down to -42 degrees F in the lab.*
- Can regular liquid water ever reach a temperature below its freezing temperature?
 - No, as the freezing point of water is 0°C , it will turn to ice at that temperature.
 - **HOWEVER**, there is an exception with undisturbed pure water. Pure water (as in no minerals or dust, etc. in the water) can be *supercooled* to temperature far below 0 degrees. But normal water (with minerals) can't become colder than 0°C .

Explore:

Science question of the day

How can we make ice cream without the use of a freezer to freeze the ice cream mixture?



Ice Cream Activity:

Students will do a fun activity where they get to make homemade ice cream by manipulating the freezing point of water.

Materials (per student)

- Two Ziplock bags of different size (preferably one sandwich size & one-quart size, same size can work too)
- ~Cup of half & half (or milk/cream, they can all work)
- $\frac{1}{3}$ tsp of Vanilla Extract
- ~ Two Tbsp of sugar (Can add more or less, personal preference)
- $\sim\frac{1}{2}$ cup of salt (Any salt can work, if the salt particles are too big/ "sharp" it may make a hole in the Ziplock bags)
- ~4-5 cups of ice (depends on the size of the Ziplock bag being used.)

Directions:

1. Students will be making two bags: a freezer bag & an ice cream bag.
2. In the smaller Ziplock bag, students will make an ice cream bag by combining 1 cup of half & half/milk/cream, $\frac{1}{3}$ tsp of vanilla, and 2 tbsp of sugar and zip it shut. Double check it by moving it around that it does not leak.
3. They will then add 4-5 cups of ice and $\frac{1}{2}$ cup of salt to the larger Ziplock bag and put the ice cream bag into the larger Ziplock bag.
4. Using gloves/mitts or wrapping a towel around the large Ziplock bag (it will get very wet), shake the bag for 5-10 minutes (depends on the size of the bag). Check the smaller bag periodically to see if it has solidified.
5. Once the ice cream has solidified, take the ice cream bag out of the freezer bag and enjoy the ice cream! (The surface of the ice cream bag will be very salty)



Tip: Because the homemade ice cream does not have any stabilizers that are present in store bought ice cream, it will melt very quickly, so eat fast!

Explain

Ice and water alone cannot create a solution cold enough to freeze the ice cream ingredients into ice cream. One method that we can use to lower the temperature of the ice cream ingredients is using salt to lower the **freezing point of water**. Adding salt makes it more difficult for the **water molecules** to form a bond and lowers the freezing point of water, which allows water to reach a temperature below its normal freezing point.

Review Science Vocabulary

Freezing point- the temperature at which a liquid turn into a solid

Freezing point depression- the salt makes it harder for the water molecules to bond together in their rigid structure. In water, salt is a solute, and it will break into its elements.

Water molecule- is composed of two hydrogen atoms, each linked by a single chemical bond to an oxygen atom.

More resources:

- Yale University Science Xplained: Ice Cream Chemistry
<https://youtu.be/k1pel10ufmk>
- What is a water molecule? <https://4hlnet.extension.org/what-is-a-water-molecule/>

Elaborate/Enrichment:

Students may have noticed that their freezer bag became very wet on the outside during the activity. This is a good example of condensation. Ask the students if they know or make a guess as to where the water outside of the bag came from. Most will say from the salt water solution, but the water actually came from the air. The water vapors (gas) in the air condensed into liquid water due to the cold freezer bag cooling the water vapor.

Evaluate

- Why do you think our homemade ice cream melts faster than store-bought ice cream?
- How can scientists investigate the freezing point of water?
- Does salt water have a different freezing point than fresh water?
- Follow EIS on [Facebook](#) and [Instagram](#) and share a picture of you and your family eating the ice cream!

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