Bruce Museum at Home

STEAM Activities for Children

Lesson # 15: Quick Chill

Week of July 6, 2020

This week's STEAM at Home lesson is another wet and wild water experiment. All the materials are easy to find. You may have most of the items in your house already. Make sure you and your learner are ready to get wet! Please plan accordingly before beginning any of these projects with your learner.

Learners will use their science journals to predict, record, and explore their experiments. If your learner hasn't made a science journal, instructions can be found here. If learners have a notebook or other paper they prefer to use, that's fine.

In order of appearance, this lesson contains: a materials list for Quick Chill, instructions for the experiment, ways to add on to the activity, a brief cooking activity, and NGSS Performance Expectations. Additionally, a list of chemistry vocabulary words is available as a separate document, and can be found here.

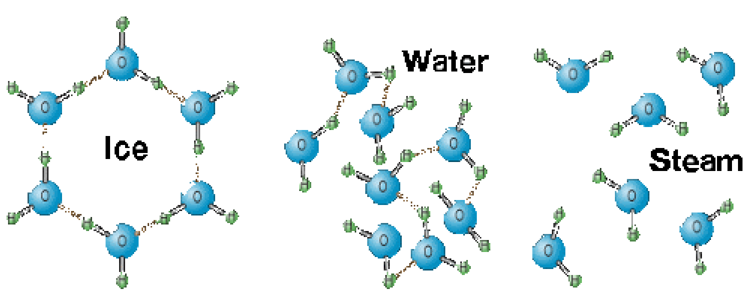
The experiment today can be a little unpredictable, it took us several times to achieve supercooled water in our home freezer. Plan ahead and make sure you have backups of the materials used, just in case things don't work out the first time

---

Materials for Quick Chill: filtered water (this is easiest to find pre-packaged in water bottles), water bottles or other containers that can go in the freezer, ice cubes, a cup or bowl, large plate or tray, writing implements, salt.

Materials for cooking project: 1 cup of half and half, 2 tablespoons sugar, 1 tsp vanilla, 3 upc ice, ½ tsp salt, toppings/add-ins of choice, 2 different sizes of Ziploc bags (we used gallon and pint).

Last week we learned a bit about what makes ice a special solid. Your learner can use their science journal to refresh their memories about the special properties of water in all three material states.

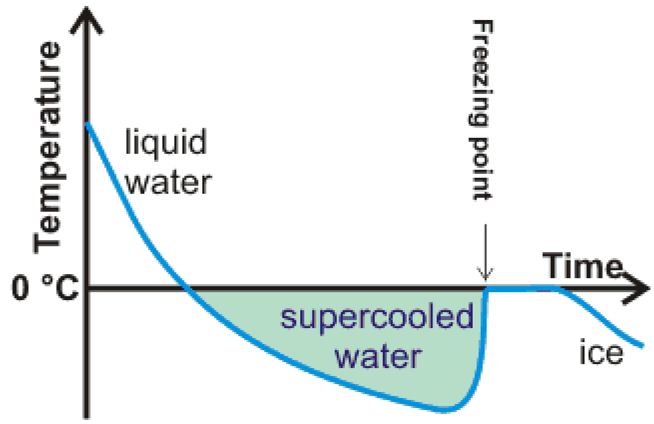


- Ice is frozen water in its solid state and forms at temperatures at or below 32 °F

- Water ice is larger in volume than liquid water.
    - Water ice has a lesser density than liquid water.
    - Water ice melts at temperatures above 32 °F but we can do things to alter this.
        - Ask your learner, what did we do last week to alter the melting point of water ice?
- Water is liquid at room temperature.
- Steam is water that has been heated until it vaporizes.

This week we will experiment with supercooled water.

- What is supercooled water?
    - Supercooled water is water that has been cooled to temperatures below freezing but has not become frozen water ice.



Ask your learner some questions to help them understand and explore the concept of a supercooled liquid.

- Why doesn't supercooled water freeze when it is below the freezing point?
- How do you think we can make supercooled water at home?
- Is there anything about the structure of the water molecule that creates the potential for supercooled water?

Scientists have discovered that water can reach -55 °F (87 °F colder than freezing!) before it freezes. Yet we say 32 °F is freezing; what's going on?

- Tap water is not (technically), pure.
    - While tap water is safe to drink there are dissolved impurities in it, like salts and other minerals.
        - Some mineral and spring waters have dissolved salts and minerals in them intentionally.
- In order for liquid water to freeze, a seed, or nucleus, ice must begin to form.
    - This is a structural change in the formation of the water molecules.
    - The impurities in tap water provide a surface for the crystallization process and act as a catalyst for freezing.
- Pure water — water without any impurities — freezes slower as it is more difficult for the molecules in liquid water to assume the physical shape of crystalline ice.
    - This is why it is able to become supercooled.
    - It is also why we will be able to do our experiment!

BRUCE MUSEUM
www.brucemuseum.org

Time to Chill Out!

This experiment needs a substantial amount of lead time, as you will need to put your bottles of pure water into the freezer and allow them to chill until almost frozen. You may need to experiment on your own with how long this will take or make this part of the experiment for your learner. It took us two days to figure out the ideal amount of time our bottles should be in the freezer.

- How can you tell if your bottles of water are ready?
    - One way:
        - Place a similar sized container of unfiltered impure water in the freezer with your bottles of filtered water.
        - The impure water will freeze before the pure water does, as it has impurities for the ice crystals to form on.
    - Another way:
        - Most water bottles take roughly 2 to 2½ hours to freeze, but it depends on the size of the bottles and freezer temperature.
        - Set a timer for two hours and check your water bottles. If they don't have ice in them, try the Chill Out experiment with one of the bottles.
            - If the experiment works, the others are also ready.
            - If the experiment doesn't work, try giving your water another 15 minutes to chill.
            - Repeat as needed.

    - Remember: Supercooled water does not have ice in it. It is still completely liquid.
- Is it easy to make supercooled liquids?
    - Not always, we had to try multiple times to get this experiment to work in our home laboratory.
- Is there any easier way to supercool water?
    - For a faster and potentially easier way to supercool water, place a clean cup of pure water in a bowl of ice.
    - The ice should reach up to the top of the cup, but no ice should get in the water or vice-versa.
    - Sprinkle the ice thoroughly with table salt, not getting any into the pure water.
    - It will take about 15 minutes for the glass of purified water to become supercooled.
        - If you place a thermometer in the purified water, it will read below freezing once the water is supercooled.

Now we've got supercooled water, what can we do with it?

- Place a plate, or tray, with a small cup or bowl of ice cubes on it in a central location.
- Gently remove a bottle of supercooled water from your refrigerator.
- Slowly pour the water onto the ice cubes.
    - If your water is supercooled, it will freeze instantly upon hitting the ice cubes.
    - Your learner can experiment with making castles and mountains of ice, long lines of ice, etc.
    - If you have made multiple bottles of supercooled water, leave the extras in the freezer as you experiment, but remember, if you leave them for too long, they will freeze completely!
- With the faster supercooled water, you can experiment with freezing the small cup of water.

Ways to add on to the experiment:

- Try making bottles of colored supercooled water with food coloring so learners can create colorful ice sculptures.
- Experiment with different sizes and styles of bottles and the amount of time needed to supercool the water.
- Is it possible to make supercooled water with tap water? Experiment and find out!

Time for a Treat

This week instead of an arts and crafts project, the add-on activity is a recipe! With all the ice and salt floating around, why not make some homemade, no-churn ice cream?

- Fill a large Ziploc bag (we used a 1-gallon bag) with ice and ⅓ cup of table salt.
- Fill a smaller Ziploc bag (we used a 1-pint bag) with 1 cup of half and half, 2 tablespoons sugar, and half a teaspoon vanilla extract.
    - Push out the extra air and seal the bag.
- Place the bag with the half and half mixture into the bag of ice and seal tightly.
- Shake the bigger bag for 7-10 minutes.
    - The half and half mixture will harden.
    - The bags will be cold; use a towel to protect your hands.

- Once the half and half mixture has hardened, remove it from the larger bag of ice, open it up, and serve.
  - Add toppings as desired and enjoy!

NGSS Performance Expectations

2-PS1-2 Matter and Its Interactions: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

5-PS1-4 Matter and Its Interactions: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

5-PS1-3 Matter and Its Interactions: Make observations and measurements to identify materials based on their properties.