BRUCE MUSEUM
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# *Bruce Museum at Home*

# *STEAM Activities for Children*

## Lesson # 14: Iced Out

## Week of June 29, 2020

This week's STEAM at Home lesson continues the theme: properties of matter. Instead of creating non-Newtonian liquids, this week's experiment is with the most elemental of materials: water. These experiments do not use materials that are difficult to source, but they are messy! 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 Iced Out, instructions for the experiment, ways to add on to the activity, a brief art activity, and NGSS Performance Expectations. Additionally, a list of chemistry vocabulary words is available as a separate document, and can be found here.

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*A note for adults: these activities will require quite a bit of ice! You may want to read through the instructions, make ice for the experiments, and then do the activities the next day.*

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**Materials for Iced Out:** ice cubes (at least 6), plates or trays for the experiment, paper for labels, a writing implement, string or thread, salt, sugar, pepper, and other dry spices, time keeping device, glass of water (doesn't have to be glass).

**Materials for art project**: watercolor paints, salt, paintbrushes, paper, water, and water containers.

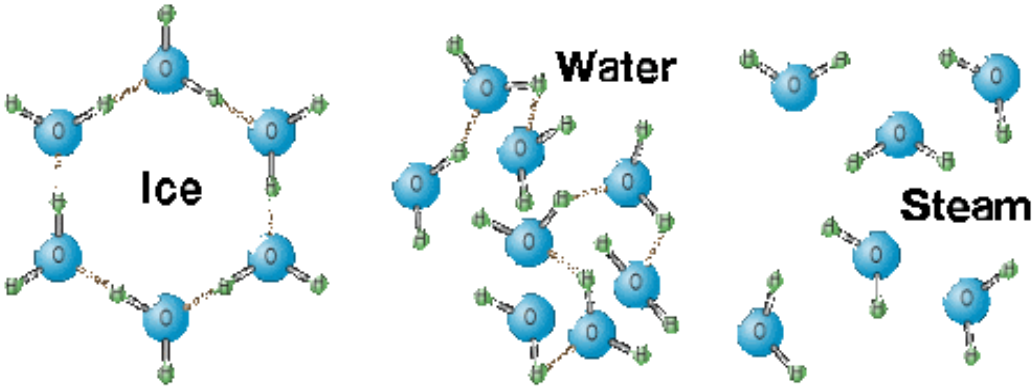
**Let's Get Frosty!**

This week we are starting a series of experiments using ice. Use this series of questions to find out what your learner already knows about ice. Learners should use their science journals to track what they know and what they still have questions about.

- What is ice made of?
- Is ice a solid, a liquid, or a gas?
- Ice is a solid; does it behave like other solids?
- How do we use ice in our daily lives?
- How do we make ice in our homes?
- When does ice appear in the outdoors?

Some basic facts about ice:


- Ice is actually water!
  - Many of the special properties of ice are due to the atomic structure of water molecules.
  - Water molecules are composed of two hydrogen and one oxygen atom and known as $H_2O$.
- Water's state of matter changes depending on its temperature, but its chemical composition, $H_2O$, does not.
  - Water is liquid at room temperature.
  - Water is gas (steam) at temperatures at or above 212 ℉ or 100 ℃.
  - Water is solid (ice) at temperatures at or below 32 ℉ or 0 ℃.
- Liquids other than water contract when they freeze, but water expands, making ice, a.k.a. solid water, larger in volume and lesser in density than the liquid water from which it formed.




  - This is because of the mouse-ear-like structure of the hydrogen atoms in the water molecule.
  - The hydrogen atoms have a weak negative charge while the oxygen atom has a positive charge.
    - These charges are what keep water molecules together in their liquid state and allow for phenomena like the meniscus and the magnet flowing water experiment.
  - When water is cooled to the freezing point, the atoms slow down and stop "flowing." This allows the hydrogens to bond together, stacking the atoms in a crystalline structure that naturally creates a larger overall volume and, therefore, lower density.

    - When ice is taken out of a below-freezing atmosphere, the water molecules gather energy from the warmer air, and this breaks the bonds between the hydrogen atoms as the atoms fall into their liquid structure.
- Technically, ice is considered a mineral because it is a naturally occurring crystalline inorganic solid with an ordered structure.
- Water is known as a universal solvent, which means many things can be dissolved into water,
    - Materials dissolved into, or contaminating, pure water can affect its freezing and melting points.
        - This is the property we will be experimenting with in Iced Out.

**Time to Chill Out!**

Your learner will be carrying out an investigation to see if they can affect the rate at which ice melts and freezes. Using their science journals, learners can write what they think melts ice and why.


- To start experimenting, you or your learner should take an ice cube out of the freezer, put it on a hard, non-porous surface, and watch what happens.
    - Unless the air is at, or below, freezing, the ice cube will begin to melt.
- Start a timer, or note the time, when the ice cube begins to visibly melt.
    - How long will the cube take to melt completely?
    - Learners should note how long the ice took to melt in their journals.
        - Did it feel like a long time or a short time?
        - Why would we want ice to melt?
        - Why would we want ice to stay frozen?
- Your learner can make notes or draw what the ice cube looks like as it melts in their science journal.

Ask your learner:

- What do we do in winter when the roads and sidewalks are icy?
    - How do we get that ice to melt?

Traditionally, we have put salt on ice to make it melt faster; below is an explanation of the chemistry behind the effect of salt on ice. Read through the explanation before conducting the experiment that follows.

- The first thing to know is that the salt does not melt the ice. In fact, it actually lowers the melting point of ice. This is called **freezing point depression**.
- While ice may look solid, there is actually a thin layer of liquid water on its surface.
- When salt (or any soluble substance) is applied to ice, it mixes with the liquid water.

- In the case of salt, this means that the ice then has a layer of saltwater covering it.
- The saltwater has a lower freezing point than pure water and cannot refreeze without an air temperature at or below 28.4 ℉ or -21.1 ℃.
- As the layer of saltwater grows, it depresses the melting point of the ice it is covering, and more and more of the ice melts.

**Melting Point Tests**

Set up multiple stations with ice cubes and a choice of substances for learners to put on the ice cubes. Learners will choose what they want to use (salt, sugar, garlic powder, etc.), and put a label in front of each cube with the name of the material they add. Then it's a matter of watching the clock and seeing how fast the cubes melt. Learners can record their results in their science journals, and you can use the list of questions below to extend the activity.

- Did any of the materials make the ice melt faster?
- Which ones worked the best; which ones didn't work?
- Did you see anything different in the behavior of the materials that seemed to melt the ice faster?
  - Your learners may notice that certain substances (sugar and salt, for example) which seem to speed up in the melting of the ice, dissolved into the water.
- What other things could we do to speed up the melting of ice?

**Ice Fishing**

Your learners can use this property of salt to depress the freezing point of ice and go fishing!

- Place a few ice cubes in a glass of water.
- Place a piece of string, approximately a foot long, on top of the glass so that the string rests on the ice cubes.
- Let the string sit on the ice cube for a few moments, then lift it up.
  - What happened? (probably nothing)
- Replace the string on top of the ice cube.
- Using a spoon, put a heaping spoonful of salt on top of the ice cube and string; wait a few moments.

- Lift the string up again.
    - What happened? (The ice cube probably stuck to the string, like a fish on a line! This may take a few tries.)

What's happening?

- The ice melts a little as soon as the ice and salt touch but refreezes a little around the string. If you measure the temperature of ice with salt on it, you may find it has actually dropped below freezing! For more information on why this happens, this link may help.

If you want to extend the activity, you can try changing some of these variables:

- Use sugar or one of the other materials tested previously.
- Swap out the water for juice, milk, saltwater, or another liquid.
- Change the amount of ice cubes.

**Painting by Sodium**

Adding different materials to paint is a great way to explore different textures and techniques. Now that we know that salt and water not only mix, but also have interesting reactions and relationships, let's experiment with adding salt to a watercolor painting.

1. Create a watercolor painting of anything you like.
2. While the paint is still wet, sprinkle the painting with a large amount of salt; the salt will stick wherever your painting is wet.
    a. If your painting is dry, you can dab it gently with a damp paper towel or paint brush.
3. Let your painting dry and gently brush the salt off your painting. You should see some fun effects where the salt was.

. Alternatively, try adding the salt before painting to see what happens.

## 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.