Cold Hard Facts

Authors: Michigan Water Stewardship Program, Eaton Conservation District, based off of 'States of Matter' by D.M. Candelora

Lesson Overview: In this activity, students will explore the relationship between the different phases of matter, be exposed to the concept of volume and its relation to height and have an opportunity to make accurate measurements (in either English or metric units).

Objectives: Students will be able to:

1. Write a hypothesis.
2. Discover what happens to water in the solid and liquid states.
3. Record data in an entry form.

This lesson meets the following Michigan Department of Education standards:

Next Generation Science Standards (NGSS):

- ✓ 2-PS1-4 - Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.
- ✓ 2-ESS2-3 - Obtain information to identify where water is found on Earth and that it can be solid or liquid.

Michigan Grade Level Content Expectations (GLCEs):

- ✓ S.IP.02.11 - Make purposeful observation of the natural world using the appropriate senses.
- ✓ S.IP.02.14 - Manipulate simple tools (ruler, meter stick, measuring cups, hand lens, thermometer, balance) that aid observation and data collection.
- ✓ S.RS.02.11 - Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities
- ✓ P.PM.02.12 - Describe objects and substances according to their properties (color, size, shape, texture, hardness, liquid or solid, sinking or floating).
- ✓ E.FE.02.13 - Describe the properties (visible, flowing, melting, dew) of water as a liquid (lakes, rivers, streams, oceans).
- ✓ E.FE.02.14 - Describe the properties (hard, visible, freezing, ice) of water as a solid (ice, snow, iceberg, sleet, hail).
- ✓ S.IP.03.11 - Make purposeful observation of the natural world using the appropriate senses.
- ✓ S.IP.03.12 - Generate questions based on observations.
- ✓ S.IP.03.15 - Make accurate measurements with appropriate units (centimeters, meters, Celsius, grams, seconds, minutes) for the measurement tool.
- ✓ S.IA.03.13 - Communicate and present findings of observations and investigations.
- ✓ S.RS.03.11 - Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.
- ✓ S.RS.03.15 - Use evidence when communicating scientific ideas.

Recommended Grade(s): 2nd Grade, 3rd grade

Recommended Subject(s): Science **Duration:** Prep time: 5 min., Activity: ~30 min

Materials Required: 1 clear plastic cup, 1 ruler, 4-6 ice cubes, water

Suggested Vocabulary for Students: hypothesis, solid, liquid, gas

Background Information for Educator: Looking at the change in volume between the solid and liquid phases is safer that looking at the gas phase because water must be heated to boiling to change to gas. The water level should fall as the ice melts. It is important that the ice cubes are floating. If there is too much ice or not enough water so that the cubes do not float, the water level will rise as the ice melts. The last question is a "trick" question since a fixed amount of matter in the gas phase does not have a unique volume. The gas will expand to fill its container so its volume is determined by that container.

Lesson Procedure:

Introduction:

~ As a class, discuss examples of solid-liquid-gas transitions with which the students are familiar.

Activity:

~ As a class, develop a hypothesis related to the following question: How will the volume of water change when it changes state from solid to liquid.
~ Test the hypothesis:
~ Put the ice cubes in the glass and fill the glass with water until the ice cubes float.
~ Measure the height of the water, being sure to include the unit of measure.
~ Based on the hypothesis, do you think the water level will go up or down as the ice melts?
~ Wait until all of the ice melts and then measure the height of the water.

Wrap up / Assessments:

~ What happens to the volume of water when it changes state from solid to liquid?

Adaptations/Extension/Enhancements:

~ What will happen to the volume of water when it changes state from a liquid to a gas?
~ What will happen to the volume of water when it changes state from a liquid to a solid?

Additional Resources:

~ MWSP website: www.miwaterstewardship.org
~ Bill Nye - what if all the ice melted on earth: https://www.youtube.com/watch?v=b6CPsGanO_U

Our MWSP logo represents the two hands of Michigan - both the upper and lower peninsulas - and caring for our water resources and water quality. The green hand symbolizes all vegetation and crops in our state and the tan hand symbolizes soils. The lighter blue water signifies the vast surface water throughout the state and the darker blue water denotes groundwater.