



TAPPING INTO MAPLE TRADITION

Lesson Title: Sugar Concentration and Hydrometers

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Grade Level: (check all that apply)
 Early Elementary (K – 2nd)
 Upper Elementary (3rd – 5th)
 Middle School (6th – 8th)
 High School (9th – 12th)

What National Agriculture Literacy Outcomes does your lesson address?

<http://www.agclassroom.org/get/doc/NALObooklet.pdf>

T4.6-8i

What Common Core Standards does your lesson address?

MS-ETS1-3.

Brief description of your lesson plan:

In this activity, students will make and test out their own hydrometer. Students will then use their hydrometer to test the sugar concentration of different grades of maple syrup.

Time: Approximately 1-2 hours

Materials:

- Ruler
- Drinking straw
- Plasticine (a brand of modeling clay - could possibly use Play-Doh)
- Small nails
- Graduated cylinders
- Maple sap (collect your own or check with a local sugar shack)
- Multiple different grades of maple syrup
- Imitation maple syrup (may be labeled as pancake syrup - ie Aunt Jemimah or Mrs. Butterworth)

Vocabulary:

Hydrometer: an instrument for measuring the density of liquids.

Background:

“Consider a rock and a piece of styrofoam, both the same size. If you put them in a bucket of water, which one sinks? As you know, the styrofoam will float, and the rock will sink. This is because the rock is denser than water, while the styrofoam is less dense than water.

An object's density is a measure of how much it weighs compared to how much space it fills. In the example above, both objects are exactly the same size, but the rock is much heavier. Therefore, the rock is denser than the styrofoam. As with solids like rocks and styrofoam, different solutions (liquids) can have varying densities, too.

Have you had the chance to go swimming in a lake and the ocean? If so, you may have noticed that it was easier to float in the ocean. Because the ocean contains more salt than most freshwater lakes, ocean water is denser than lake water. Objects float higher - or displace less liquid - in solutions with greater density.

A hydrometer uses this principle - density - to measure how much sugar is in sap. If you take a sample of sap from two different trees, the sap containing more sugar will be denser than the sap containing less sugar. A hydrometer measures how dense sap is by recording how much water is displaced when it floats in the sap.

The hydrometer will displace less water (will float higher) in sap that contains more sugar than it will in sap that contains less sugar. Hydrometers use this information to record the sugar concentration of maple sap.”¹

Interest Approach – Engagement:

Start the lesson off by discussing what a hydrometer is. (A hydrometer is a device used to compare the densities of liquids and to indicate the specific gravity of a liquid. This is done using a Brix scale). How could a hydrometer be useful to maple producers?

Procedures: ²

Part 1:

1. Before starting the experiment, have the students identify which solution they believe would be more dense (tap water, salt water and sap) and why?
2. Insert the nails into the drinking straw and have one end of the straw sealed shut with plasticine.
3. Using a ruler, mark a scale on the drinking straw. Place a mark every 2 millimetres. Make every 5th mark darker. This will make it easier to accurately judge how low it floats in different liquids
4. Lower the hydrometer into a graduated cylinder with 100 ml of water in it. The density of water is 1.0 gram/ml.
5. If the hydrometer sinks to the bottom, you may have to remove one nail, if it floats to the top, a nail may need to be added. Add and/or remove nails as needed until the hydrometer floats with the second darkened line equal to the water line. This means that the hydrometer has been calibrated
6. Once the students have made their hydrometers, give them the opportunity to test them out on different solutions. These solutions can include tap water, salt water and sap. Remember that the lower in the solution the hydrometer goes the higher the density of that solution.
7. Make sure you test one solution at a time. Fill the cylinder with 100ml of salt water and place the hydrometer in the solution. Read the density on the hydrometer and record the results in the attached chart. Take the hydrometer out and repeat the step, on the same solution, two more times. Repeat the steps for the water and sap as well
8. Record all results in the attached chart and answer the attached questions
9. When finished the experiment, talk to the students about how a hydrometer may be beneficial to the production of maple syrup.

Part 2:

1. Before starting the experiment, have the students identify which solution they believe would be more

dense (sap, grade A amber, grade A golden, etc) and why?

2. Fill the cylinder with 100ml of sap and place the hydrometer in the solution. Read the density on the hydrometer and record the results. Take the hydrometer out and repeat the step, on the same solution, two more times. Repeat the steps for the the syrups.
3. Discuss with students their results. Are there difference in the sugar concentration between the different grades of syrup?

Did you know? (Ag Facts):

Maple syrup is denser than water and milk, if poured on maple they will float on top.³

Enriching Activities:

The sugar concentration of the imitation maple syrup is likely going to be different than that of the natural syrup. Why is is that? What could it be made of? Test other sugar liquids to determine their density and find one that is close to the density of the imitation syrup.

Sources/Credits:

1. <http://maple.dnr.cornell.edu/kids/hydrometer.htm>
2. <http://mrsbader.com/pdf/8-3-4-FluidsandWaterSystems/Hydrometer.pdf>
3. <http://www.science-explorers.net/blog/syrup-is-thicker-than-water>