Extension Activity:

"<u>Won't You BB My Hydrometer</u>?"

Teacher's Overview

The most obvious difference between fresh water and ocean water is the amount of salt in ocean waters. Students may also understand that the addition of salt to water may change some of the properties of that water. One very important change resulting from the addition of dissolved salts is an increase in the density of the water. For students to fully understand the nature and properties of water, it may help to have them investigate density in a comparison of fresh and salt water.

Water that contains dissolved substances has a greater mass per unit volume (density) than pure water. For example, if three (3) grams of salt are dissolved in 100 ml of fresh water, the resulting mixture is 3 percent heavier than the same amount of fresh water. Salinity of water is usually measured in "parts per thousand" and indicates the amount of total salt dissolved in one kilogram (1,000 ml) of ocean water. Generally, the greater the salinity of ocean water, the greater its density. Open ocean water has an average salinity of about 35 parts per thousand (or 3.5 percent).

Students may know that it is easier to float in the ocean (or the Great Salt Lake) than in a swimming pool. If there is more salt dissolved in water, less water must be displaced by a floating object. Thus, the denser the water, the higher an object may float. This activity is designed to have students investigate density by building their own hydrometer and then using it to measure the density of selected samples of water.

This activity may be especially suited for Earth Science or Marine Science classes involved in a study of water. The first part of the exercise requires students to read and follow directions in building a hydrometer. This simple device is used by both scientists and non-scientists to measure the relative density of solutions. In the second part of the activity, students will use their hydrometers to track the addition of salts to alter the density of water. At the beginning, the egg in part two of this extension activity has a higher density than the fresh water and thus sinks when placed in the beaker. With the addition of salts to the water, the water's density increases. When it has a higher density than the egg, the egg floats to the surface. The density of the egg remains constant throughout the activity, while the density of the water increases as salt is added. Encourage students to follow the principles of good research and to make predictions.

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Student Extension Activity:

"Won't You BB My Hydrometer?"

In the first part of this activity, you will construct a hydrometer -- a device that allows you to compare the densities of different liquids. The word "hydrometer" means *water* (hydro) *measure* (meter). You will use your hydrometer to investigate how the addition of salts affects the density of water.

Objective: Students will successfully construct a hydrometer and use it to determine the density of water samples.

NEVADA SCIENCE STANDARD 10:12.3

Time: Two to three class periods

Materials for Part One (per group): plastic medicine dropper, sharp scissors, fine-tip marking pen, metric ruler, 20 BBs, 500 ml beaker, masking tape, modeling clay, food coloring, pickling salt, waste container, graduated cylinder

Procedure for Part One:

1. Get all needed materials from your teacher.
2. Use scissors to enlarge the opening of the dropper. (see Figure 1) Try to put a BB into the dropper. If the BB fits, go on to step #3. If the BB doesn't go through the opening, cut off more of the dropper's tip.
3. Cut a piece of masking tape about 6 cm in length. Place it on a hard surface (your desk?) on which you will be able to pull off the tape without ruining it. Place the metric ruler next to the tape and transfer the cm and 1/2 cm markings to the tape. (Your tape should look similar to the one in Figure 2.) Now wrap the tape around the dropper.
4. Add 400 ml of water to the beaker; add a drop or two of food coloring to the water.
5. Put 12 more BBs into the dropper so that all the BBs rest in the bulb of the dropper.
6. Lower the bulb end of the dropper into the colored water and release it. The bulb should remain under water with the open end floating vertically in the water.
7. Add BBs to the dropper one at a time while it is floating in the colored water. Stop adding BBs when only 1 or 2 cm of the dropper tube remains above the water.
8. Plug the open end with a small piece of modeling clay as shown in Figure 3.
9. Place the dropper back into the colored water. If it floats so that the surface of the water is anywhere between the 0.5 cm and the 2.0 cm marks, your hydrometer is complete. (see Figure 4)
10. If the hydrometer does not float properly, remove the clay plug and the BBs, go back to Step 5 and proceed as directed. Once your hydrometer floats as described, you can use it to measure how the density of water changes as salt is added.

11. Place the hydrometer, bulb end down, in the colored water. Wait until it stops bobbing up and down.
12. Look at the numbered lines on the tube of the hydrometer. Determine the number of the line that rests on the surface of the colored water. Write this number in the Data Table for Part 1. If the hydrometer floats so that the water level is between two numbered lines, estimate the level where the tube touches the surface of the water.
13. Use the graduated cylinder to measure out 15 ml of pickling salt and pour it into the colored water. Using the hydrometer as a stirring rod, gently stir the water until all the salt has dissolved. Be careful not to disturb the clay plug.
14. Wait until the hydrometer stops bobbing up and down in the water. Determine the number of the line that is just touching the surface of the salty water in the same way you did in Step 12. Write this number in the Data Table for Part 1.
15. Add another 15 ml of pickling salt to the water, stir as you did in Step 13, and read the hydrometer when it stops moving. Record your observation for "colored water + 30 ml of salt" on the next line of the Data Table.
16. Complete the Data Table for Part 1 by adding salt 15 ml at a time. Stir and make hydrometer readings.
17. When all readings are completed, dump the solutions into the waste container.

HYDROMETERS

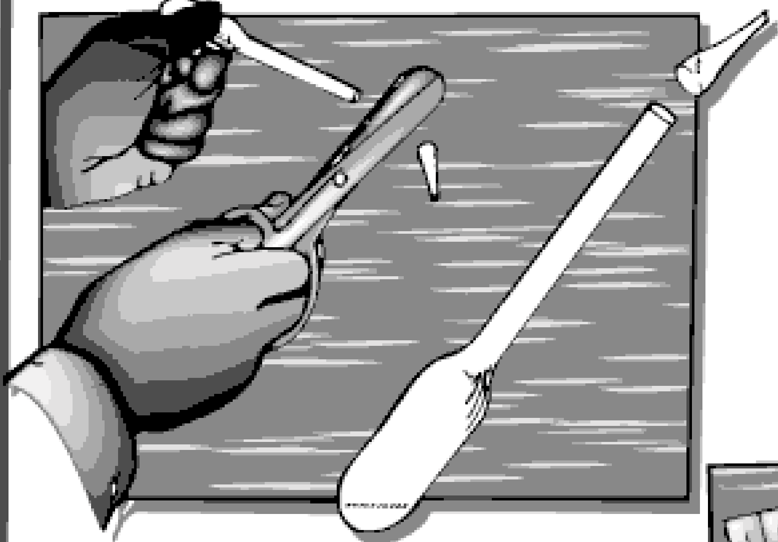

Figure 1

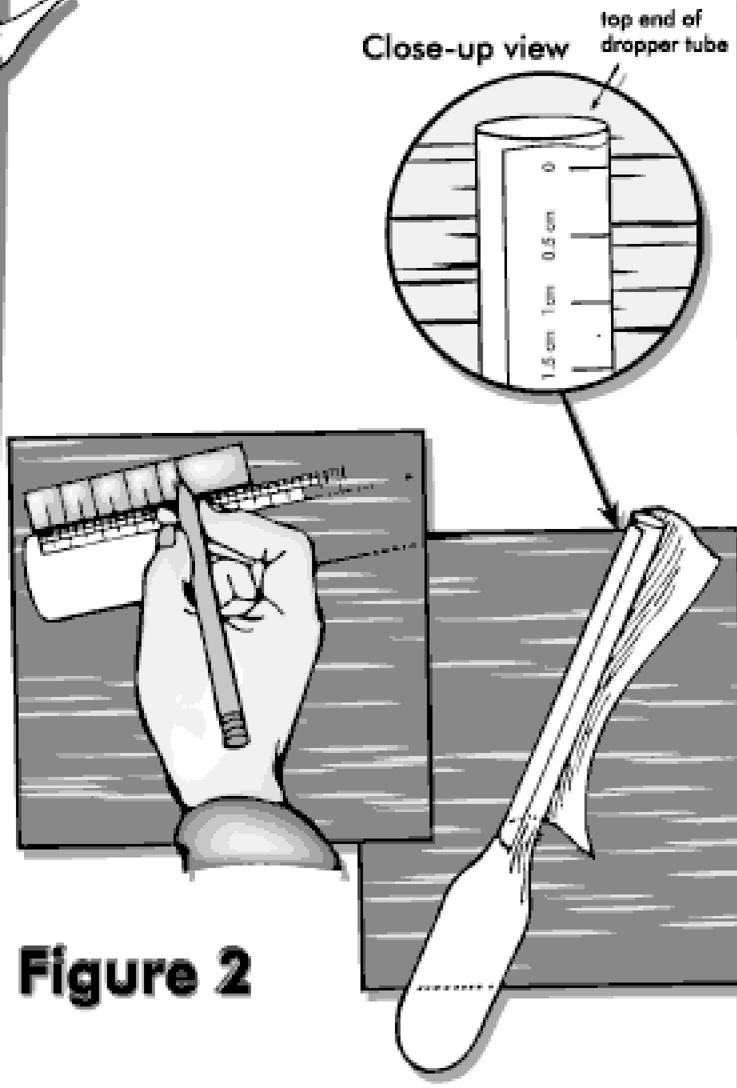

Figure 2

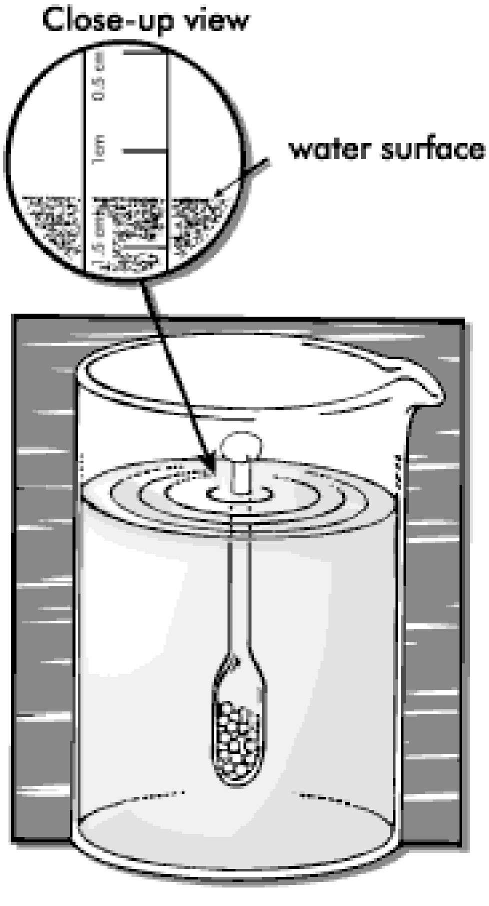

Figure 4

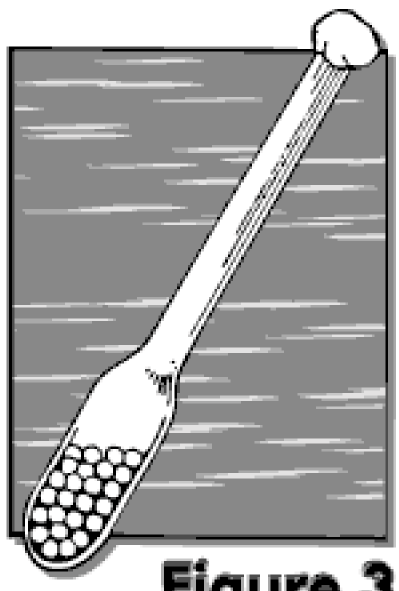

Figure 3

"An Egg In Water"

Materials for Part Two (per group): large jar or beaker, pickling salt, soup spoon (large enough for egg), 100 ml graduated cylinder, hard-boiled egg, ruler or straight edge, 5 ml metric measuring spoon, hydrometer (from Part 1)

Procedure for Part Two:

1. Use the graduated cylinder to fill the jar or beaker about 3/4 full with fresh tap water. In the Data Table for Part 2, record the amount of water you place in the beaker and, using your hydrometer from Part 1, measure and record the water's density. Remove your hydrometer from the beaker.
2. Using the soup spoon, carefully lower the egg (don't drop it!!) into the water and observe what happens. Record your observations in the Data Table for Part 2.
3. Remove the egg from the water. Use the measuring spoon to add 10 ml of salt. Use the ruler or straight edge to level the salt in the spoon before adding it to the water. Add the salt to the water and stir thoroughly with your soup spoon. Measure the density of the solution with the hydrometer. Record the hydrometer reading in the Data Table for Part 2. After you remove the hydrometer, carefully put the egg back into the beaker. Record your observations in the Data Table for Part 2.
4. Repeat step 3 until a change occurs. Record all observations.
5. Discuss results and observations among group members and respond to the questions under "Conclusions." Write your responses to the questions on other paper using complete sentences and correct spelling.

Extension Activity:

Conclusions

1. The more salt that is dissolved in a solution, the __________________ [higher/ lower] the hydrometer floats.

2. A hydrometer reading of 4.5 cm would mean that ___________ [no salt/some salt/ lots of salt] is dissolved in a solution.

3. If ocean water gives a reading of 2.5 cm on your hydrometer, what reading might you get if you test fresh water? ____________ [1 cm, 2.5 cm, 3.5 cm]

4. Describe how the addition of salt affects some of the properties of water. Is the density of the water increasing or decreasing as salt is added to the water? How do you know whether the change is an increase or a decrease?

5. If an ocean-going ship is loaded with cargo so that 15 meters of the ship rides below the surface of the water, what would you expect to happen when the ship enters the Mississippi River, which is only 16 meters deep at some points?

6. What happened when the egg was placed in fresh water?

7. Discuss any differences noted when the egg was placed in salt water compared to when it was placed in fresh water.

8. How many milliliters of salt did you have to add to make the egg behave differently?

9. Why do you think things float better in salt water than in fresh water? What does the addition of salt do to the properties of the water?

10. Compare your results with the results from the rest of the class. Based on the class results, calculate the average amount of salt per 1000 ml of water required to float the egg. Predict how much salt would be needed to float the egg in 20 liters of water and also in 300 liters of water. Show your math.

11. Why is it easier to swim in the ocean than in a lake or swimming pool?