Activity #4 - Making and Using a Hydrometer

Concepts # 7, 8, 10, 11

#7 Water with the most dissolved salt tends to form the bottom layer (most dense).
#8 Water with the least dissolved salt usually forms the top layer.
#10 Salt content of water is measured in grams of salt per kilogram of seawater (g/kg), expressed as parts per thousand (o/oo, or ppt).
#11 A hydrometer is a tool used to determine density (and, with temperature, salinity) of a water sample.

Objective:

Students will build a hydrometer to measure the densities of fresh and salt water samples.

Materials:

- distilled water (1 gal)
- 100 ml graduated cylinder
- clay (modeling)
- fine-tip permanent marking pen
- straw
- thermometer
- water samples
- temperature-density-salinity conversion graph
- laboratory balance or scale
- salt
- real hydrometer (for optional part II)

"Unknown" test solutions (to be mixed ahead of time) :

A. 33 grams salt to 1000 ml water at room temperature
B. 34 grams salt to 1000 ml water at room temperature
C. 34 grams salt to 1000 ml water at 10^{O}C (keep in refrig. overnight and remove 1 or hours before using)
D. 35 grams salt to 1000 ml water at room temperature

Procedures:

Part I **- making and using your own hydrometer.**

1. Press a small ball of clay into one end of a straw to form a plug. This straw will become a hydrometer.
2. Add fresh water to a graduated cylinder to the 100 ml line. [Note: in this investigation you will make all your readings on your hydrometer. The graduation lines on the cylinder are not used as data].
3. Put the hydrometer (straw) in the fresh water. Remove or add clay until the hydrometer floats with just the upper (approx. 1") tip exposed to the air, the rest underwater.
4. Carefully make a small horizontal line to mark the point where the surface of the water meets the straw with a permanent marker and label it "0" because no salt has been added to the water yet.
5. Remove the hydrometer. Add 1 gram of salt to the cylinder water. Dissolve all salt. Replace the hydrometer.
6. Make a line where the straw meets the water line and label it "10" (because 1 g of salt was added to 100 ml of water to make a solution with a salinity of 10 o/oo).

7. Remove the hydrometer. Add 1 more gram of salt to the cylinder water. Dissolve all salt. Replace the hydrometer.
8. Make a line where the straw meets the water line and label it "20" (because a total of 2g of salt was added to 100 ml of water to make a solution with a salinity of 20 o/oo).
9. Remove the hydrometer. Add 1 more gram of salt to the cylinder water. Dissolve all salt. Replace the hydrometer.
10. Again, make a line where the straw meets the water line and label it "30."
11. For your data observations, write a statement about the scale created on the straw.
12. Use your hydrometer to test the unknown salt solutions prepared by your teacher. Write down the salinity of each. You will estimate if the water comes between your lines.

Part II **- using a real hydrometer (if available) to determine salinity**

1. Fill the graduated cylinder with water sample "A"
2. Record water temperature and density.
3. Use the temperature-density-salinity conversion graph to find the salinity.
4. Repeat the above procedure with samples "B," "C" and "D."

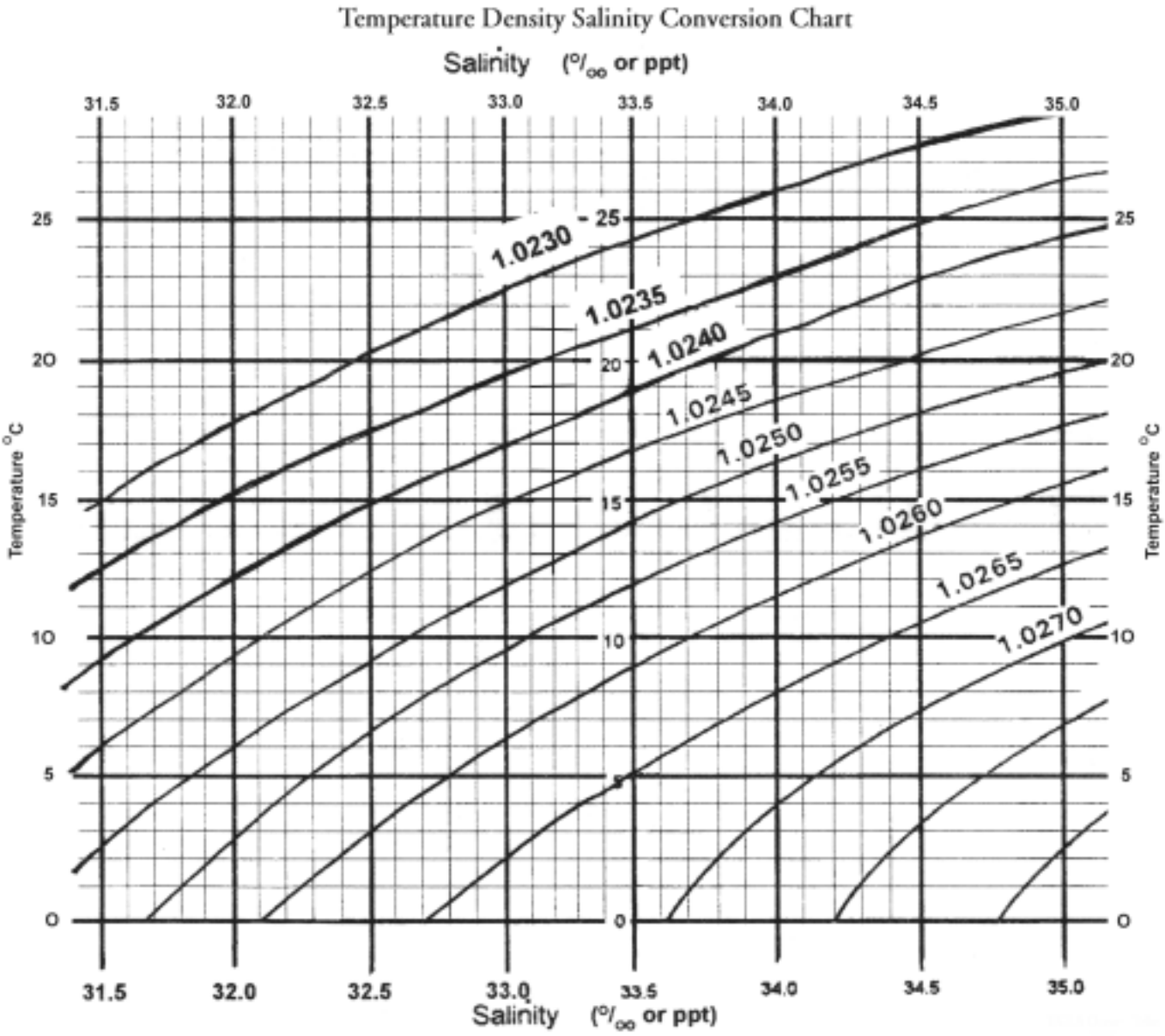
Evaluation:

- How did the salinity recordings you made with your straw hydrometer compare with the salinity you measured with the commercial hydrometer for solutions A, B, C and D?
- Which would be the surface water? __(**A**)_____. Which would be the bottom sample? __(**C**)_____.
- Which solution was the saltiest? (The bottom sample will be more saline)
- The range of salinity in seawater is between 25 ppt. (parts per thousand) to 40 ppt. Did any of the samples fall in this range? (All should fall within the given range.)
- What are two conditions that might account for this range in ocean salinities? (Many things can help explain the range in salinities: fresh water inflows, rain water, evaporation, mixing, etc.)
- Where would you expect the lowest salinities to be found? (Lowest salinities would be found in areas with fresh water inflows, lots of rain, and low evaporation rates. Usually these conditions are more prevalent in the temperate zones.)
- Where would you expect the highest salinities to be found? (Highest salinities would be found in areas with low fresh water inflow, low rainfall, and high evaporation rates. Usually these conditions are more prevalent in tropical areas and enclosed seas.)

Activity #4 - Making and Using a Hydrometer

Student Data Chart

	Part I Straw Hydrometer	Part II Commercial Hydrometer		
Sample	Salinity o/oo	Temp OC	Density g/cm3	Salinity o/oo
A				
B				
C				
D				



Place one finger on the SST line.
Use another finger to follow the density curve to the SST line.
Where the two intersect, go straight up or down to read salinity.

Record salinity values to one decimal place accuracy.