

3.3.2 Lab: How Does Temperature Affect Water Density?

Earth Science, Semester 1

Points Possible: 50

Name _____

Date _____

How Does Temperature Affect Water Density?

Ocean water temperatures vary from equator to pole and change with depth. Temperature, like salinity, affects the density of seawater. An increase in salinity will increase density of seawater. However, the density of seawater is more sensitive to temperature fluctuations than salinity. Cool surface water, which has a greater density than warm surface water, forms in the polar regions, sinks, and moves toward the tropics.

Problem How can you determine the effects of temperature on water density?

Procedure

Read the procedure and make sure you understand it so you can interpret the data provided.

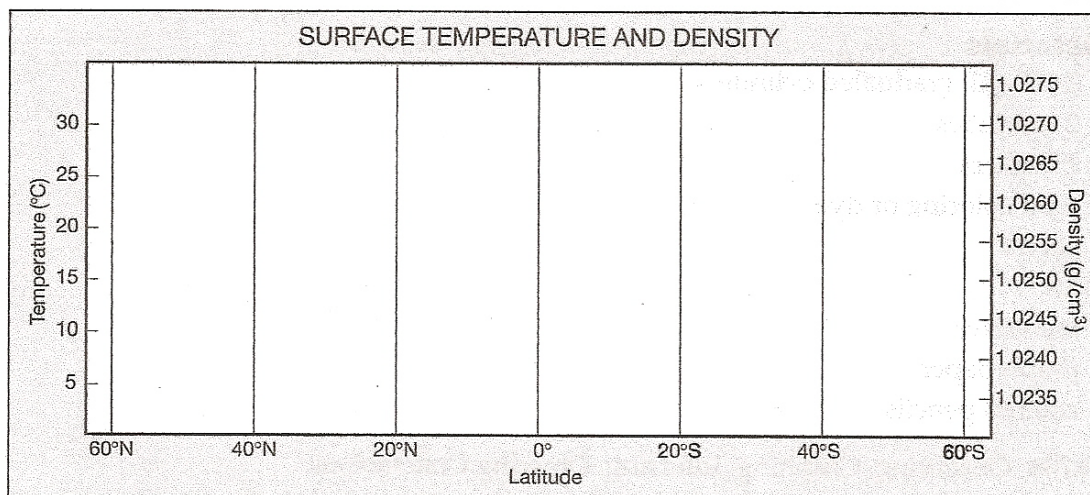
1. In a beaker, mix cold tap water with several ice cubes. Stir until the water and ice are well mixed.
2. Fill the graduated cylinder with 100 ml of the cold water from the beaker. The graduated cylinder should not contain any pieces of ice.
3. Put 2 to 3 drops of food coloring or dye in the test tube and fill it half full with hot tap water.
4. Pour the contents of the test tube slowly into the graduated cylinder. Record what happened – refer to Table 1.
5. Add a test tube full of cold tap water to a beaker. Mix in 2 to 3 drops of food coloring dye and a handful of ice to the beaker. Stir the solution thoroughly.
6. Fill the test tube half full of the solution from Step 5. Do not allow any ice into the test tube.
7. Fill the second graduated cylinder with 100 mL of hot tap water.
8. Pour the test tube of cold liquid slowly into the cylinder of hot water. Record what happened – refer to Table 1.

Part A

Table 1: Observation of Water Mixed at Different Temperatures

Trial	Temp of 100 mL of Water in Beaker	Temp of 5 mL of Water + Food Coloring in Test Tube	Observations When Liquid in Test Tube is Added to Beaker
1 (Step 4)	1°C	43°C	The warm water mixed with dye did not sink below the cold water.
2 (Step 8)	41°C	0°C	The cold water mixed with the dye sank below the warm water.

Part B



- Using the information in the Data Table 2, plot a line on the above graph for temperature vs. latitude. Using different colored pencil, plot a line for density vs. latitude on the same graph.

DATA TABLE 2 Idealized Ocean Studies Water Temperature and Densities at Various Latitudes

Latitude	Surface Temperature (°C)	Surface Density (g/cm ³)
60°N	5	1.0258
40°N	13	1.0259
20°N	24	1.0237
0°	27	1.0238
20°S	24	1.0241
40°S	15	1.0261
60°S	2	1.0272

Analyze and Conclude

1. **Observing** What difference did you observe in the behavior of the hot and cold water samples from Steps 4 and 8? Which water sample was the most dense in each experiment?
2. **Inferring** How does temperature affect the density of water?
3. **Drawing Conclusions** If two water samples of equal mass had equal salinities, which sample would be more dense: Water Sample A, which has a temperature of 25°C, or Water Sample B, which has a temperature of 14°C? Why?
4. If the two water samples below had equal temperatures, which one would be more dense:
 - Sample A - with a salinity of 20% or
 - Sample B – with a salinity of 35%

Explain why:

5. **Interpreting Diagrams** Describes the density and temperature characteristics of water in equatorial (0° latitude) regions. Compare these characteristics to water found in polar (60° N) regions.
6. **Inferring** For similar latitudes (40°S and 40°N). Compare the surface water density in the Northern and Southern hemisphere. What might cause these differences?