

HOT HOT HOT

A STUDY OF THE EFFECTS OF TEMPERATURE ON WATER.

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ABSTRACT

The purpose of this investigation was to define the relationship between TEMPERATURE and DENSITY of a liquid such as water. Increasing the temperature of water causes an increase in the volume of water. Temperature does not change the mass of water since no water is added or taken away. An increase in the volume of a substance with no change in mass will cause the density to decrease.

In order to demonstrate this relationship between TEMPERATURE and DENSITY, I took 100 milliliters of water and placed it in a container that could be heated. First I measured the temperature. Then, I applied heat to the water using an alcohol burner and checked and recorded the volume with each 5 degree Celsius change in temperature.

As expected the volume of the water increased with the addition of heat and an increase in temperature. This increase in volume causes a decrease in the density of the water. Warm water will “float” on top of cooler water due to the difference in density. This explains why when you swim in a pool, the warmer less dense water is found at the surface of the pool and the cooler more dense water is found at the bottom of the pool.

TESTABLE QUESTION

What effect does changing temperature have on the density of a liquid such as water?

PREDICTION / HYPOTHESIS

If temperature is related to density, then an increase in the temperature of water will cause a decrease in the density of the water.

I think this will happen because increasing the temperature of the water causes the molecules to move further apart from one another. This increases the volume however, it does not change the mass because no molecules of water are being added or taken away – just the distance between them is being changed. Increasing the volume while keeping the mass the same will cause a decrease in density.

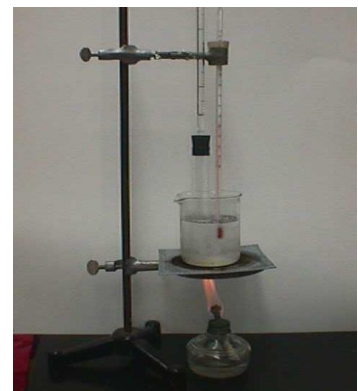
EXPERIMENTAL DESIGN

To complete this experiment, I set up the lab equipment as illustrated:

Ring Stand, 250 mL Beaker, Thermometer, Test tube with rubber stopper and Pipet attached (to measure volume change) , alcohol burner and screen.

Then I completed the following in order:

1. Obtain 200 mL of water and placed in a heat safe beaker to be used as a water bath to heat the test tube of water safely.
2. Placed a known volume of water in a test tube with pipet attached at the top (to measure volume change).
3. Place test tube and thermometer in water bath and record both volume and temperature.
4. Light alcohol burner.
5. Record volume change of water with each 5 deg Celsius change in temperature in data table.
6. Continue to collect data until water reaches 80 degrees Celsius. (Avoid boiling the water as this will cause a substantial amount of water to boil off changing the mass considerably)

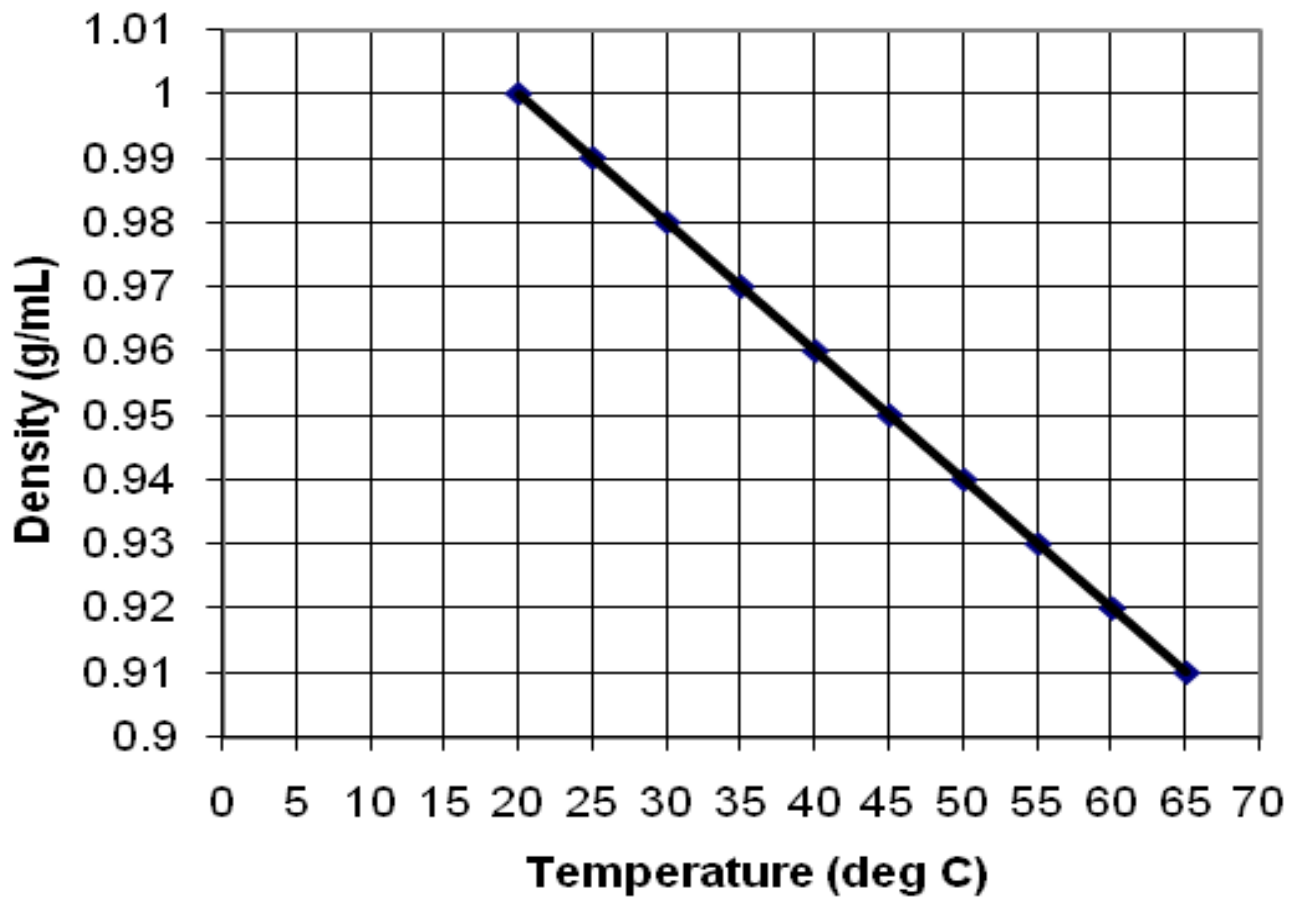


OBSERVATIONS / DATA

The following data was collected with each 5 degree change in temperature and graphed below.

Temperature (deg celsius)	Mass (g)	Volume (mL)	Density (g/mL)
20	100	100.00	1
25	100	101.00	0.99
30	100	102.00	0.98
35	100	103.00	0.97
40	100	104.00	0.96
45	100	105.00	0.95
50	100	106.00	0.94
55	100	107.00	0.93
60	100	108.50	0.92
65	100	109.50	0.91

Temperature vs. Density



CLAIMS & EVIDENCE

From the data, the following claims can be made. Evidence in the form of data is used to support each claim.

CLAIMS	EVIDENCE
<p>I claim that...</p> <p>An increase in temperature causes an increase in volume.</p> <p>An increase in temperature causes a Decrease in the density.</p>	<p>I know this because...</p> <p>Changing the temperature from 20 degrees to 30 degrees caused a 2 milliliter change in volume.</p> <p>Since mass stays the same, the 2 milliliter change in volume causes a decrease in density according to the equation:</p> <p>Density = mass/volume</p>

CONCLUSION

From this investigation I can confirm that temperature does indeed affect the density of a liquid such as water. This supports my prediction/hypothesis. Increasing the temperature of the water caused an increase in the volume of the water. Although the volume increases with an increase in temperature, the mass does not since we are not adding or removing water – only heating it. Using the equation for density: $\text{density} = \text{mass} / \text{volume}$, I was able to calculate that with each increase in temperature, the density decreases. This information helps to explain why water at the bottom of my pool feels considerably colder than the water at the surface. The warmer water is less dense and floats on top of the cooler, more dense water at the bottom of the pool.