Measuring density

Topic

Scientific methodology.

Timing

20 min.

Description

In this experiment students determine and compare the density of tap water and seawater using a small measuring cylinder and a sensitive balance.

Apparatus (per group)

- One student worksheet
- One 5 cm^3 measuring cylinder
- One sheet of graph paper
- Access to a balance that reads to 0.01g.

Chemicals (per group)

Solutions contained in plastic pipettes, see 'Apparatus and solutions guidelines' handout.

- Tap water
- Seawater

Observations

Specimen results are given overleaf. From these results it is possible to distinguish the density of tap water and seawater using this method. The experiment is simple to do although students must work carefully to get good results.

A wealth of data are produced which when examined and interpreted show the application of mathematics to experimental science. In particular this shows the value of treating data graphically.

Students could be told that it was as a result of appreciating the significance of small differences in mass that important scientific discoveries have been made. For example, in 1894 William Ramsay and Lord Raleigh discovered the element argon in air by investigating the small but consistent discrepancy between the (higher) density of nitrogen obtained from air by removing the oxygen (atmospheric nitrogen) and nitrogen prepared from its compounds (*eg* heating ammonium nitrite solution).

Note

You will require a balance that reads to 0.01 g.

Specimen results measuring the densities of seawater and tap water

Seawater	**Tap water**

Vol (cm^3)	Mass (g)	Density (g cm^{-3})	Vol (cm^3)	Mass (g)	Density (g cm^{-3})
0.5	0.563	1.126	0.5	0.533	1.066
1.0	1.089	1.089	1.0	1.052	1.052
1.5	1.597	1.065	1.5	1.540	1.027
2.0	2.093	1.047	2.0	2.041	1.021
2.5	2.594	1.038	2.5	2.516	1.006
3.0	3.118	1.039	3.0	3.031	1.010
3.5	3.609	1.031	3.5	3.505	1.001
4.0	4.123	1.031	4.0	4.004	1.001
4.5	4.644	1.032	4.5	4.503	1.001
5.0	5.144	1.029	5.0	4.999	1.000
mean density 1.053			mean density 1.018		

Extension

It may be interesting to extend this experiment to measure the relative densities of, for example, Coke® and Diet Coke®.

Safety

There are no significant hazards associated with this experiment.

Measuring density

In this experiment you will be measuring the mass and volume of seawater and tap water and then using your data to determine the density. (Density = mass / volume)

Instructions

1. Place the measuring cylinder on the balance pan and tare the balance.
2. Carefully add 0.5 cm^3 of tap water dropwise to the measuring cylinder. Record in a table the volume of water added and the mass.
3. Add drops of tap water until the volume is 1.0 cm^3. Record the new mass.
4. Add water until the volume is 1.5 cm^3 and record the mass.
5. Continue in this manner at 0.5 cm^3 intervals up to 5.0 cm^3.

(If you cannot tare the balance, subtract the mass of the measuring cylinder each time.)

Repeat the whole process using seawater.

Questions

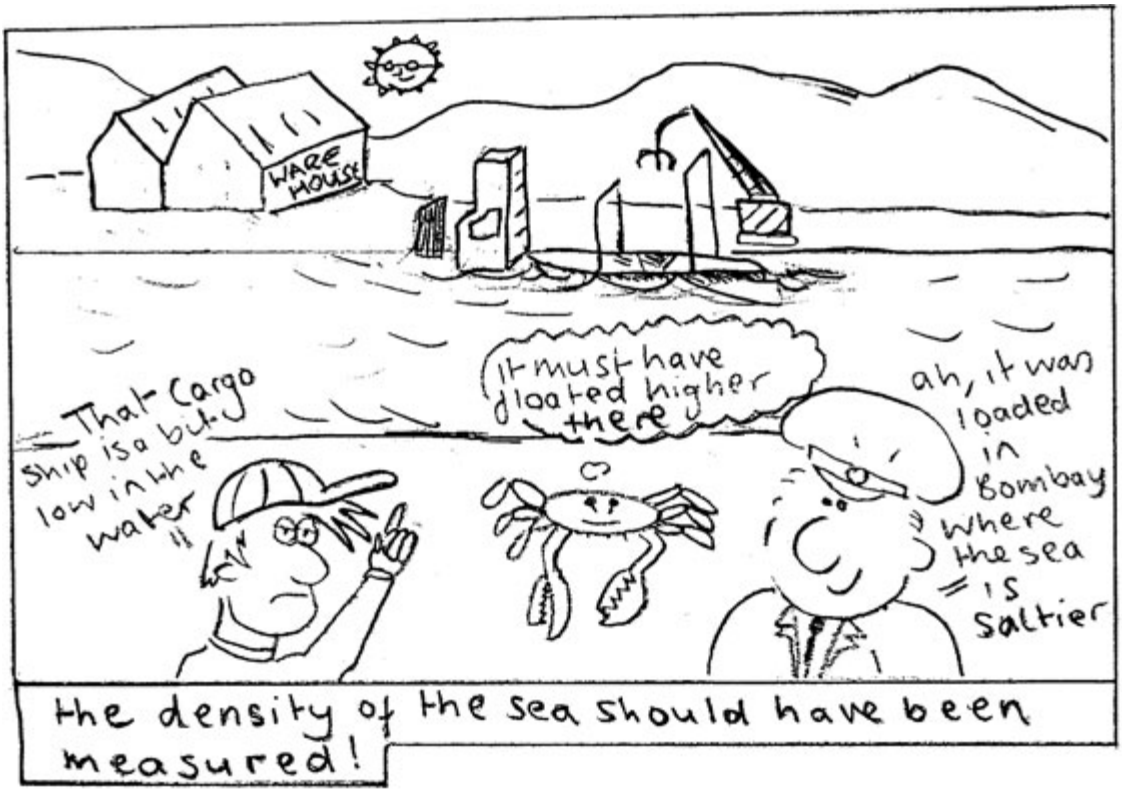
Make a table of your results (as shown below).

Seawater			**Tap water**		
Vol (cm^3)	Mass (g)	Density (g cm^{-3})	Vol (cm^3)	Mass (g)	Density (g cm^{-3})

On a piece of graph paper plot the volume against the mass for both tap water and seawater and draw a best line fit through each set of points. Measure the slope of these lines.

Questions

1. What do you notice on measuring the slope of the lines on your graph?
2. What are the advantages of showing your results graphically rather than just in a table? (You may wish to use a spreadsheet package to do the calculations.)



Credits

Health & safety checked May 2018

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