Investigating ☑ Communicating ☐ Knowledge and understanding ☑

Density Experiment

Learning outcomes in focus

Students should be able to:

NS4 Produce and select data(qualitatively/ quantitatively)**, critically analyse data** to identify patterns and relationships, **and justify conclusions**

PW1 Select and use appropriate measuring instruments

PW2 Identify and measure/calculate length, mass, time, temperature, area, **volume, density** and speed

Learning intentions

We are learning:

- how mass and volume affect density and to apply our knowledge of the relationship between these two factors to determine how the floatation of objects could be improved
- to design, plan and conduct an investigation to measure mass and volume
- to select the appropriate equipment for measuring the volume of different sized and shaped solids
- to calculate the density of both liquids and solids
- to produce data on density and analyse it
- to identify patterns in relation to floatation
- to draw and justify conclusions on why a solid floats or sinks in a liquid

Teaching and Learning Context

This task was given to second year student. Prior learning included opportunities for designing planning and conducting investigations, explaining how fairness, safety and selection of suitable equipment was considered (NS3), analysing data to identify patterns and relationships, drawing and justifying conclusions (NS4), calculating mass and volume (PW2)

Task

Measure the volume (using L x W x H or displacement of water, where applicable) and mass of various solids and liquids and calculate the corresponding densities. Using observations, on which objects sank in water and their equivalent densities, conclude why objects sink or float. Finally hypothesise whether objects will sink or float in liquids of different densities.

Success criteria:

I can:

- **SC1:** measure accurately the mass of regular & irregular solids using an electronic balance
- **SC2:** measure the volume of a regular shape like a cuboid using length x width x height
- **SC3:** measure the volume of the regular/irregular shaped objects using displacement of water
- **SC4:** give one advantage & disadvantage of displacement of water / L x W x H for measuring volume
- **SC5:** evaluate and explain whether displacement of water or L x W x H is more accurate for measuring volume of objects
- **SC6:** calculate the densities of the liquids and solids using the correct formula
- **SC7:** critically analyse data, make a justified conclusion as to why objects sink and float
- **SC8:** recommend methods of increasing or decreasing the density of a liquid/ solid

Density Experiment

Q1. Looking at the 8 solids provided which do you believe will sink in water and why?

I believe the magnet, butter, glass blocks will sink because these solids are the heaviest out of the 8 solids tested. The rest of the solids are lighter and I believe they are light enough and the particles are spaced out enough to float on water.

Q2.

Fill in the following table using the equipment provided

Solid/Liquid	Mass	Volume Method 1	Volume Method 2
Magnet *	32.9	17.6	19
Soap Block *	127.1	112	110
Butter —	254.3	305.453	760
Oxo Cube —	6.6	7.6	10
Wooden Block —	77.0	144.3	164
Glass Block *	349.8	142.025	124
Lemon —	94.4		108.0
Lime *	70.3		72
Water	140.6		140.0
7up	63.9		70.0
Oil	45.8		50.0

SC1,2: Accurate representation of figures to one decimal place. All results correspond to actual figures.

SC3: Inaccuracies in figures, especially items that floated.

Q3.

i)What are the advantages and disadvantages of Method 1 for measuring volume?

The advantages of method 1 for measuring is the accuracy but the disadvantages is - that it can only be used for objects with perfectly straight sides and flat faces. It's also easy to make calculation errors when multyplying length by width by

ii)What are the advantages and disadvantages of Method 2 for measuring volume?

Method 2 for measuring volume is very accurate but if the object floats then it needs to be pushed under the surface of the water which causes more water to flow out that makes the answer bigger than the actual volume. An advantag is it can be used for objects of every shape and also for liquids.

iii)Which method for measuring volume do you believe to be the most accurate?

method 2

iv)Explain the reason for your choice

I chose method 2 because it can be used for objects of all shapes and also for liquids.

SC4: Detailed explanation of disadvantages, doesn't explain why it's accurate (RULER) in advantages.

SC4: Thorough and clear explanation of the advantages and disadvantages. Expands on the difficulty with floating objects.

SC5: Misunderstanding the meaning of accuracy. Reasoning below emphasises the most useful rather than the most accurate.

Q4 Can you calculate the density of all the liquids and solids?

Liquid/ solid	Density (Mass ÷ Volume)
Butter	0.978 g/m³
Soap	1.155 g/m³
Magnet	1.732 g/m³
Oxo Cube	0.66 g/m³
Wooden Block	0.469 g/m³
Glass Block	2.821 g/m³
Lemon	0.944 g/m³
Lime	0.976 g/m³
Water	1 g/m³
7up	0.912 g/m³
Oil	0.91 g/m³

SC6: Accurate representation of figures but incorrect units.

Q5 Look at the densities. Can you make any conclusion as to why an object sinks or floats in water?

An object floats when its density is less than that of water because when density is more than that of water the particles are closer together than the particles in water.

SC7: Justified conclusion based on results. Identified the pattern between the objects that float and their corresponding densities being less than 1g/cm3 but has not explained the connection between an object that sinks and waters density.

Q6 Based on your conclusion above, can you predict which objects will float in the 7up?

I think the oil, the oxo cube and the wooden block will float because their density is less than 7ups density.

SC1: Apart from taking oil as an object this prediction is perfectly in line with results. Can make acceptable hypothesis from previous conclusion.

Q7 If you were to mix the three liquids together, what do you expect might happen?

wate r would be at the bottom, 7 up would Float on the water and oil would float on top of the 7up.

Q8. i) Is there any way that you could change the density of water?

(Hint: Why is it easier to float in the sea than in a swimming pool?)

Sea water is densier than water because normal gaps between particles in water are filled by salt in sea water.

ii)Give an explanation for you answer to Q8 (Why will it change density?)

It will change density because the mass increases therefore the density in creases also.

SC7: Understands that due to different densities the liquids will float on each other similar to an object. Doesn't consider miscibility of water, & 7up.

SC8: Has an extensive understanding of the principle behind changing the density of an object. Realises increasing mass increases density but omits how volume is a constant.

Q9.Calculate the density of the play dough and describe the method you used?

Place the playdough on the electronic balance to get the mass (86.4 g) fill an overflow can with water and drop the playdough in, the water will overflow into a graduated cylinder (volume -> 67 cm^3) calculate density by dividing mass by volume (86.4 g ÷ 67 cm^3 = 1.29 $g cm^3$)

Q 10.

i)Will the play dough float or sink in water and give your reason?

Sink because it's density is greater than 1 (waters density)

ii)Is there a way to make the play dough float by itself?

Yes ☑ No ☐

iii)Explain you answer

Some people in my group think that if you half the mass of the playdough it will float but I do not think this as it's density will remain the same. The best way to make it float is too change the shape of the playdough by doing so you increase the volume & making the density decrease, because the mass stays the same.

SC7: Emphasises that the student understands the principle on which flotation works.

SC8: Shows independent opinion from group and justifies reason why. Offers personal opinion supported with sound rational.

Overall judgement: Above expectation