Grade 8 Science - Fluids **Why do things float?**

Name: _____Answer Key_____ Class: _____ Date: _____

This is a mixed activity in which we will be doing some measuring and some use of given data

1 a) State Archimedes' Principle in terms of buoyancy.

An object in a fluid displaces the fluid it is in. The displaced fluid is has the same volume as the object. The displacement creates a force that works upward (it works against gravity). If the mass of the displaced water is greater than the mass of the object, it will float.

1 b) How does Archimedes' Principle explain whether an object will float or sink in water?

If the density of the object is less than the density of the fluid the object will float

If the density of the object is more that the fluid, it will sink.

3. Use your understanding of Archimedes' Principle to predict whether the following objects will float or sink in water. You will be given an object that you will measure and calculate the volume. You will then take the mass and calculate the density.

Describe your object:

Length (to the nearest tenth of a cm): Answers will Vary

Width (to the nearest tenth of a cm): Answers will Vary

Height (to the nearest tenth of a cm): Answers will Vary

Volume (L x W x H) Answers will Vary

Mass: Answers will Vary

Density (m/V): Density = mass / volume (answers will vary after this line)

Now calculate the density of each of the following:

a) Object A, with a mass of 15.7 grams that displaces 15.9 milliliters of water

density = m/V

= 15.7g / 15.9cm^3

= 0.99 g/cm^3 ∴ The density of object A is 0.99 g/cm^3.

b) Object B, with a mass of 4.2 grams that displaces 1.6 milliliters of water

density = m/V

= 4.2g / 1.6cm^3

= 2.625 g/cm^3 ∴ The density of object B is 2.63 g/cm^3.

c) Object C, with a mass of 9.4 grams that displaces 4.7 milliliters of water

density = m/V

= 9.4g / 4.7cm^3

= 0.2 $/cm^3$ ∴ The density of object C is 0.2 g/cm^3.

d) Object D, with a mass of 11.4 grams that displaces 19.7 milliliters of water

density = m/V

= 11.4g / 19.7cm^3

= 0.5787 $/cm^3$ ∴ The density of D is 0.58 g/cm^3.

5. The largest passenger ship in the world is the *MS Harmony of the Seas* which is 362m long and has a displacement of about 120,000 t. In comparison, the *RMS Titanic* was 269m long and had a displacement of about 52.000 t. Since both ships are made of metal, how are they able to float (even temporarily)?

Metal has a high density but ships are designed to have a shell of metal that has a lot of open space inside that is filled with air. This displaces a lot of water and, since water is heavy, it creates a buoyant force that makes the ship float. The ship will push away the same mass of water as the ship's mass so the buoyant force is equal to the gravitational force on the ship's mass. Archimedes Principle states that an object displaces the fluid that it is in and creates a buoyant force eqhal to the mass of the displaces fluid.

Data and Calculations:

Material	Mass (g)	Water Displaced (mL or cm^3)	Density of material (g/cm^3)	Sink or Float?
Wood	13.30	15.6	0.85	Float
Aluminum	5.60	1.1	5.09	Sink
Plastic	4.00	4.1	0.98	Float
Lead	20.00	1.8	11.11	Sink
Cork	4.00	8.1	0.49	Float
Steel	8.30	1.6	5.19	Sink
Clay	15.60	8.5	1.84	Sink
Rubber	5.90	4.9	1.20	Sink
Candle	10.40	10.5	0.99	Float

Conclusion: In order to see if something will float, how can you use the density of an object to see if it will sink or float?

If the density of the object is less than the density of the fluid, it will float and if it is less than the density of the fluid, it will sink.

Reflection: *Did you enjoy this Lab? Explain.*

Answers will vary

Does it Float Lab – Extension

The conclusion of the lab is that any material or object that has a density that is less than the fluid will be supported by the buoyant force of that fluid. Water has a density of 1g/mL or $1g/cm^3$.

Air is also a fluid. It has a density of 0.00128g/mL. Since gases are much less dense than solids and liquids, we usually represent them in g/L since these units are much smaller. Therefore, the density of air is 1.28g/L.

Go online and find the density of the following gasses and then determine if they float or sink in air. Some of these values were given in a previous handout.

Gas	Density	Sink or Float in Air?
Hydrogen	0.00009	Float
Nitrogen	0.00123	Float
Carbon Dioxide	0.00194	Sink
Chlorine	0.00312	Sink
Helium	0.00018	Float
Radon	0.00973	Sink

Conclusion:

When we have a gas with a container, we have to take the overall density (like in a hot air balloon, helium balloon, airship, etc.). It is the same as with a submarine, a huge ship or a scuba tank. Most items you want to control the buoyancy in order to control the amount upward or downward force. We do this by changing the relative density – either through heat or through volume changes.