



NATURAL SCIENCES: NATS4

LESSON 14

NOTES AND ACTIVITY – US 7509

THEME: Matter and Materials
TOPIC: Density

At the end of this unit, you should be able to:

1. Define the term “*density*”.
2. Apply and manipulate the formula of density in calculations.
3. Distinguish floating and sinking materials using density
4. Explain how density of water can be altered.

WHAT IS DENSITY

1. Density can be defined as follows:
 - The mass of the substance divided by its volume
 - the amount of mass in a specified space (volume)
 - the mass per unit volume of matter.
2. Density can also express the relationship between the mass of the substance and how much space it takes up (volume).
3. The denser an object is, the less likely it is to float and vice versa.

FORMULA FOR DENSITY

1. From the definition, density *is the mass of the substance divided by its volume*; the formula is derived:

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

where : Density (D) – measured in *gram per cubic centimeter (g/cm³)* or
kilogram per cubic meter (kg/m³)

: mass (m) – measured in *gram (g)* or *kilogram (kg)*

: volume (v) – measured in *cubic centimeter (cm³)* or *cubic meter (m³)*

2. Referring back to the statement number 2 above in **WHAT IS DENSITY**, density can express the relationship between the mass of the substance and how much space it takes up (volume).

The following can be established:

- Density is *directly proportional* to the mass of the substance – meaning that by increasing the mass of the substance, its density also increases.
- Density is *indirectly (inversely) proportional* to the volume of the substance – meaning that density decreases when the volume of the substance increases.

TABLE OF DENSITIES OF SOME SUBSTANCES

Since **matter** is defined as *anything that has mass and occupies space*, so matter could be solid, liquid or gas as they occupy a defined space (i.e. volume).

SUBSTANCE	DENSITY (g/cm ³)	PHASE OF MATTER
Air	0.0013	Gas
Wood (Oak)	0.85	Solid
Water	1.00	Liquid
Ice	0.93	Solid
Aluminium	2.7	Solid
Lead	11.3	Solid
Gold	19.3	Solid
Ethanol	0.93	Liquid

FLOATING AND SINKING SUBSTANCES

Water is generally used to test floating or sinking ability of substances.

- Floating substances are generally **less dense** than water. This means that their density is lesser than that of water.
For example: Ice (0.93 g/cm^3) will float on water (1.00 g/cm^3).
- Sinking substances are **denser** than water.
For example: Gold (19.3 g/cm^3) sinks in water (1.00 g/cm^3)

WORKED EXAMPLES

- a) A substance that weighs 95 grams occupies 250 cm^3 . Calculate its density.

Data: Mass = 95 grams Volume = 250 cm^3 Density = ?	$\text{Density} = \frac{\text{mass}}{\text{volume}}$ $\text{Density} = \frac{95}{250}$ $= 0.384 \text{ g/cm}^3$
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- b) Gold's density is 19.3 g/cm^3 . Calculate its volume (*to the nearest tenth*) if it weighs 5 kg.

Data: Density = 19.3 g/cm^3 Mass = 5 kg = 5000 g Volume = ?	$\text{Density} = \frac{\text{mass}}{\text{volume}}$ $19.3 = \frac{5\,000}{\text{volume}}$ $\text{volume} = \frac{5\,000}{19.3}$ $= 259.067\dots$ $= 260 \text{ cm}^3$
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Note !!!

To calculate the mass of a substance, use the formula:

$$\text{mass} = \text{density} \times \text{volume}$$

ACTIVITY

1. Substance A weighs 125 grams with a volume of 200 cm³ and substance B of mass 125 grams occupies a space of 120 cubic centimeters.

Which substance A or B is having a bigger density? Show all your calculations.

(5)

2. Study the table and answer the questions.

Material	Density (g/cm ³)
Gasoline	0.7
Gold	19.3
Lead	11.3
Water	1.00
Mercury	13.6
Paraffin (wax)	0.87
Platinum	21.4

- 2.1 Is Gasoline a gas or liquid? (1)
 - 2.2 The density of mercury is 13.6 g/cm³. What does it mean? (2)
 - 2.3 Identify TWO materials made from crude oil. (2)
 - 2.4 Which material would sink the quickest in water? Why this is so? (3)
 - 2.5 If water were to be boiled. Would its density **STAY THE SAME, DECREASE** or **INCREASE**? (1)
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