CONSERVATION OF MATTER

RECALL

- There are 2 types of changes in matter:
  - **Physical**
    - At the end of the change, the substance is still **chemically the same**
  - **Chemical**
    - At the end of the change, the substance is **chemically different**

CONSERVATION OF MATTER

- **The Law of Conservation of Matter states:**
  - **Matter is never created nor destroyed; it is only ever rearranged.**
- This holds true for **chemical and physical changes**

CONSERVATION OF MATTER

- Matter can **change** but **cannot just disappear or appear out of nowhere**
- In other words, during a chemical reaction, **everything you start with you must end up with** (but it might look different).

A LITTLE HISTORY

- A long time ago, the ancient Greeks already proposed that the **total amount of matter in the universe is constant**

A LITTLE HISTORY

- The law of conservation of mass/matter though was only officially formulated in the late 18th century by **Antoine Lavoisier**

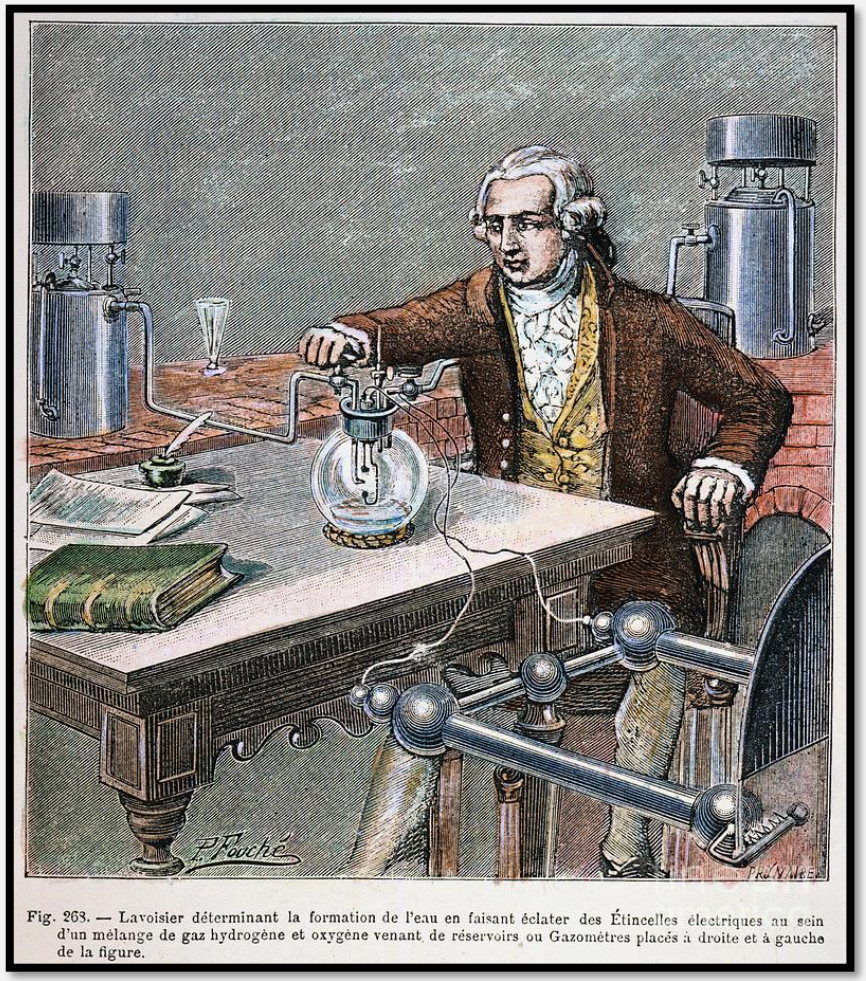


Fig. 263. — Lavoisier déterminant la formation de l'eau en faisant éclater des Étincelles électriques au sein d'un mélange de gaz hydrogène et oxygène venant de réservoirs ou Gazomètres placés à droite et à gauche de la figure.

WHY IS IT IMPORTANT?

- This was an immense discovery and helped the scientific world move from **alchemy to modern chemistry**

WHY IS IT IMPORTANT?

- And in a more complex way, it helped **Einstein** develop the **theory of relativity**
- $\mathbf{E = mc^2}$

WHAT DOES IT MEAN FOR US?

- Basically, you need to understand that:
  - In a reaction, **the end product** will have **the same mass as the total mass of the reactants**

WHAT DOES IT MEAN FOR US?

- Example:
  - What would be the mass of chocolate milk produced if I add 30g of Nesquik powder to 280g of milk?

30g + 280g = 310g

DENSITY

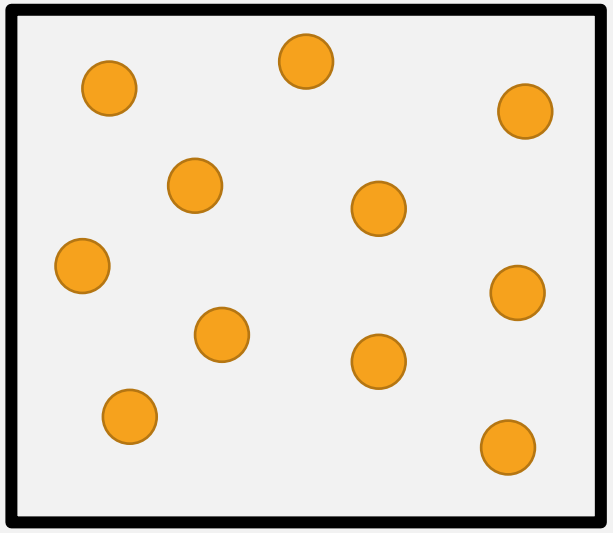
WHAT IS DENSITY?

- **Density** is a **characteristic property** of an object that describes the relationship between the object's **mass and volume**

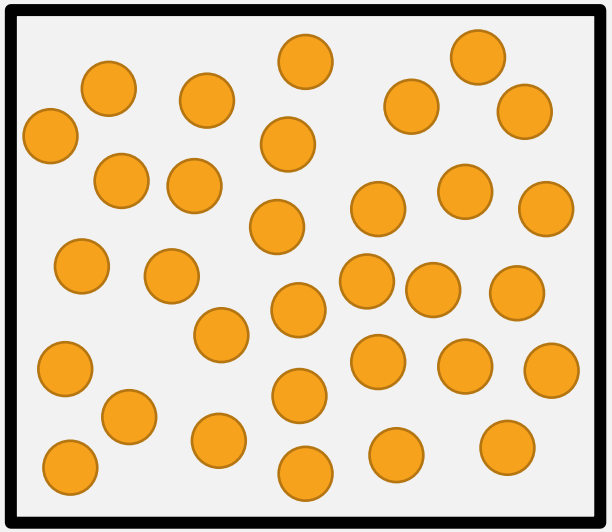
WHAT IS DENSITY?

- Each particle in the following picture has the same mass and the objects are the same size. Which object is denser?

A



B

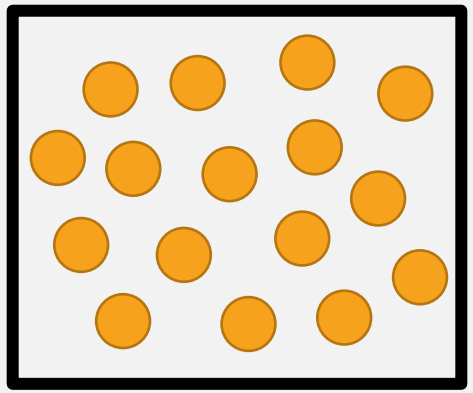


B is denser because it has **more** mass for the **same** volume

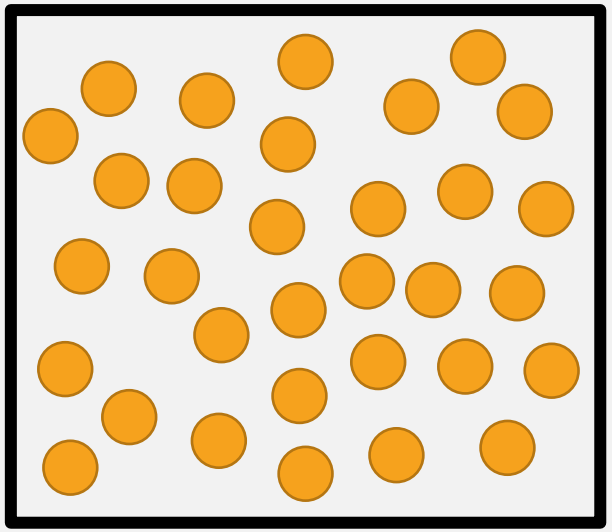
WHAT IS DENSITY?

- What happens if the objects are not the same size? How would you figure it out?

A



B



Would need to calculate **mass ÷ volume**

WHAT IS DENSITY?

- **The formula to calculate density is:**

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

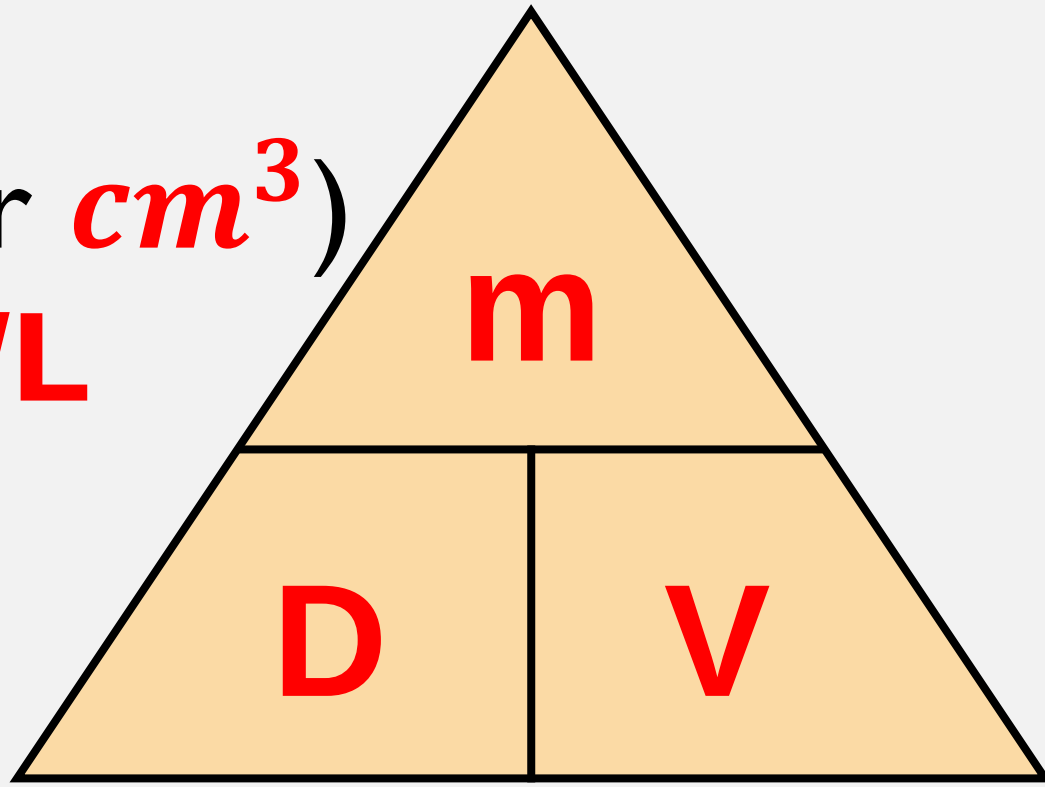
DENSITY TRIANGLE

- We can represent this equation as a triangle

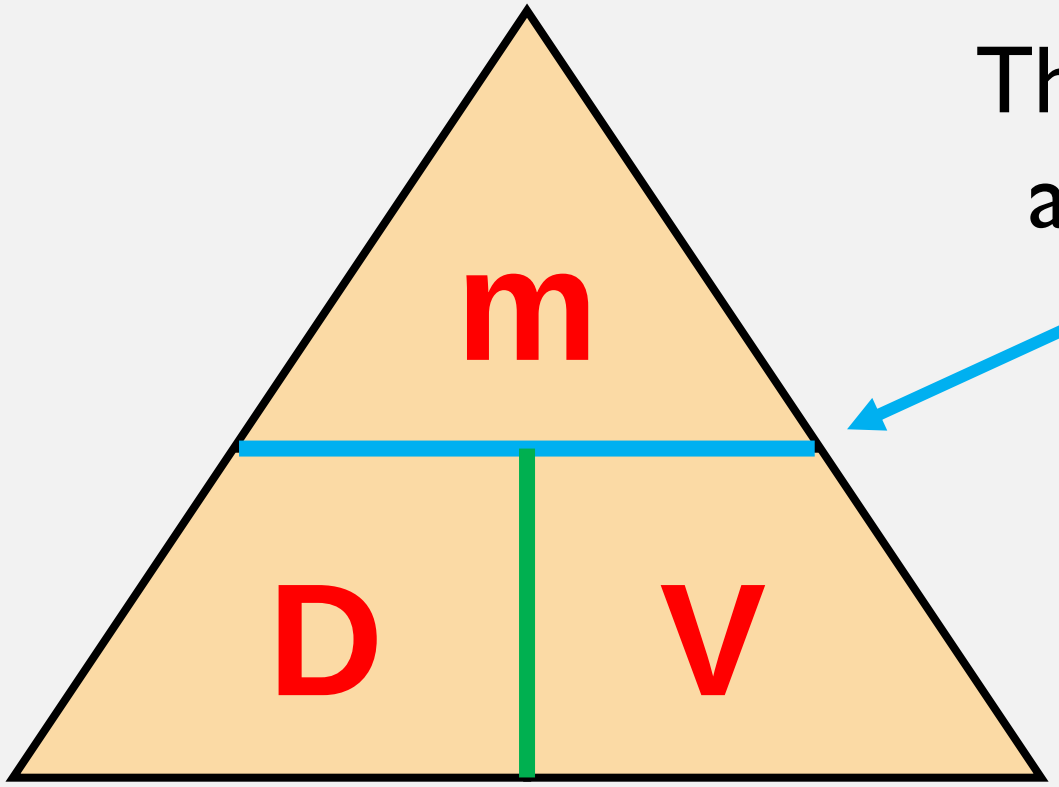
m = **mass** (**g**)

V = **volume** (**mL** or **L** or cm^3)

D = **density** (**g/mL** or **g/L** or g/cm^3)



DENSITY TRIANGLE



This line represents a **division** (like a fraction)

This line represents a **multiplication**

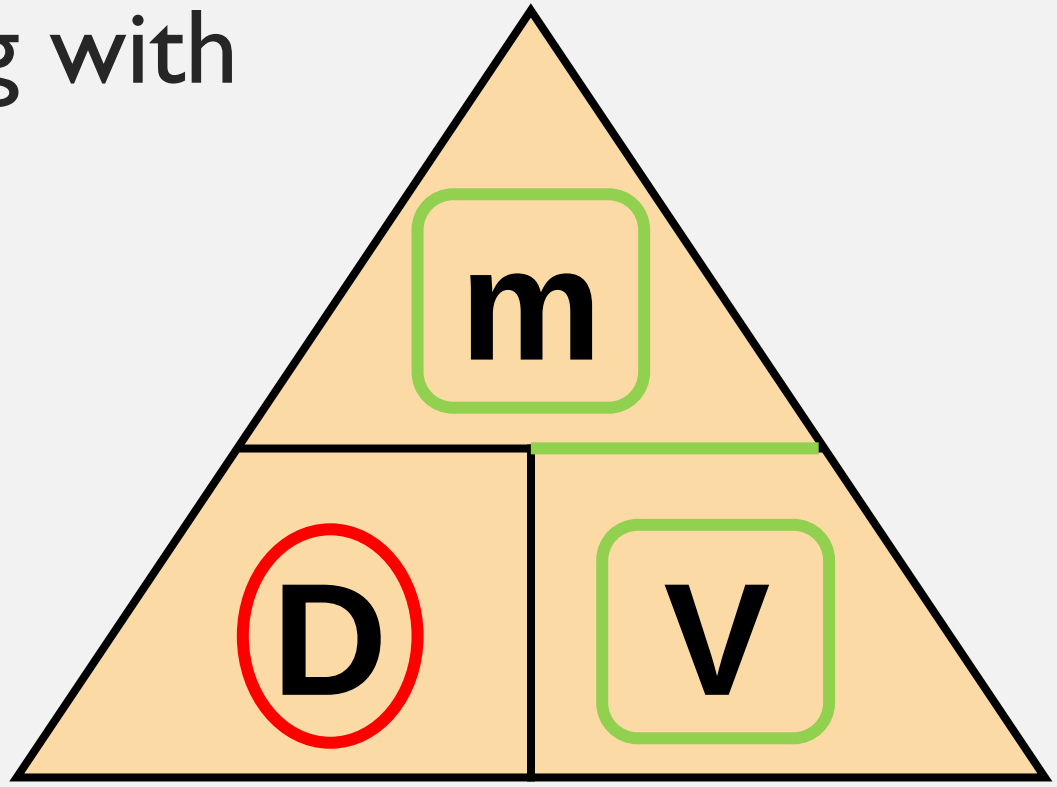
USING THE TRIANGLE

- Calculating **Density**
  - Write your formula, starting with what you are looking for:

$$D =$$

  - Now read your triangle:

$$D = \frac{m}{V}$$



EXAMPLE

- What is the density of a ring that weighs 24g and has a volume of $12cm^3$?

$$D = \frac{m}{V} = \frac{24g}{12cm^3} = 2g/cm^3$$

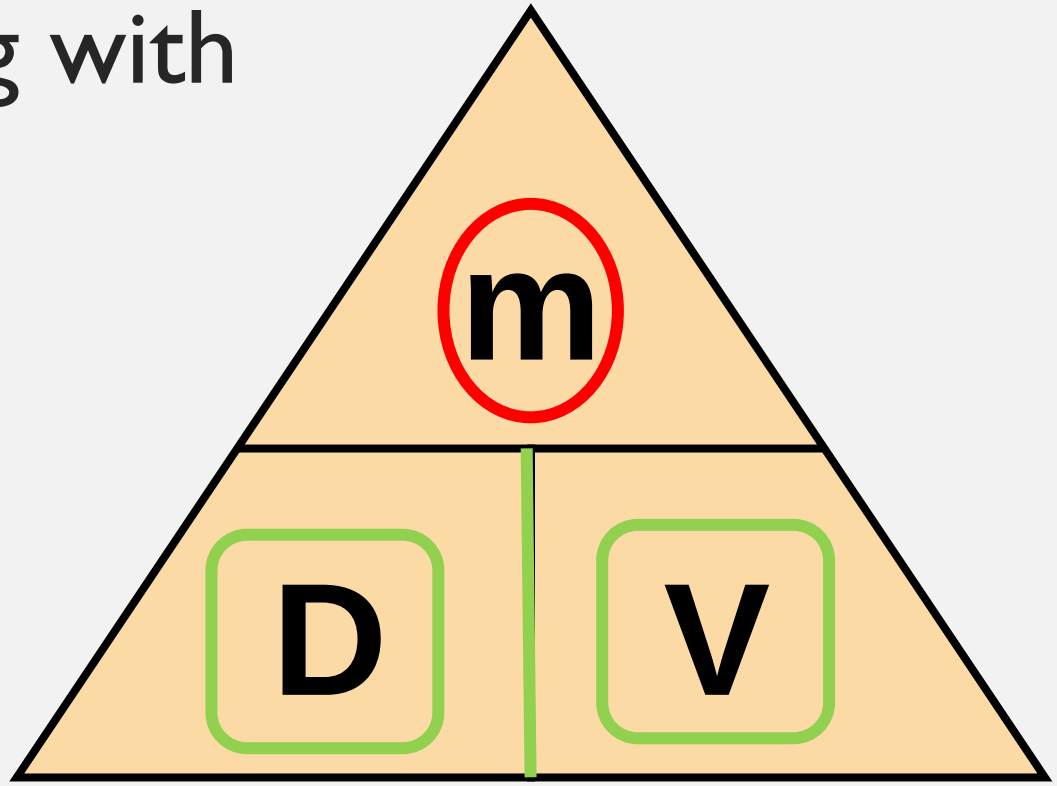
USING THE TRIANGLE

- Calculating **Mass**
  - Write your formula, starting with what you are looking for:

$$m =$$

  - Now read your triangle:

$$m = DxV$$



EXAMPLE

- What is the mass of 120mL of water if the density is 1g/mL?

$$m = DxV = \frac{1g}{mL} \times 120mL$$

$$= 120g$$

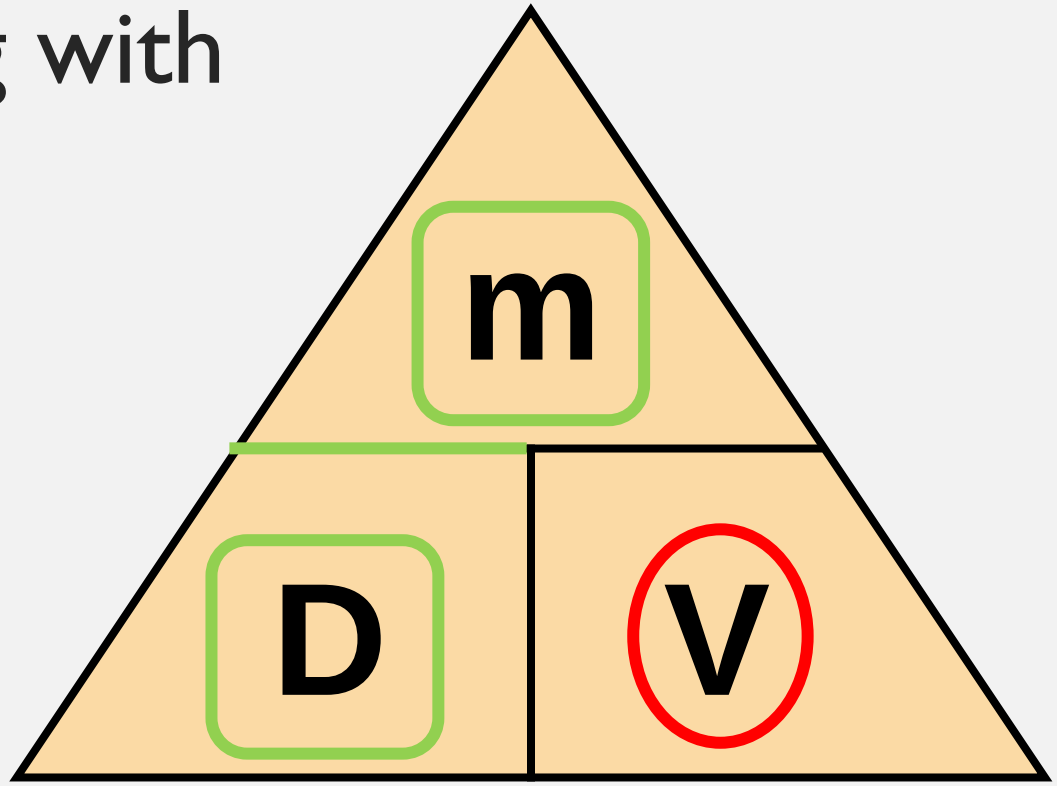
USING THE TRIANGLE

- Calculating **Volume**
  - Write your formula starting with what you are looking for:

$$V =$$

  - Now read your triangle:

$$V = \frac{m}{D}$$



EXAMPLE

- What is the volume of a 250g cube if the density is 9.08g/cm^3?

$$V = \frac{m}{D} = \frac{250g}{9.08g/cm^3}$$

$$= 27.53cm^3$$

DENSITY SUMMARY

Density of Water = 1g/ml

	Regular	Irregular	Liquid	Unit
Mass	weigh	weigh	Liquid mass	g
Volume	L x w x h	Water displacement	Measure grad. cyl.	mL or cm^3
Density	$\frac{\text{Weight}}{\text{L x w x h}}$	$\frac{\text{Weight}}{\text{Water dis.}}$	$\frac{\text{Liq. Mass}}{\text{Vol. G.C.}}$	g/mL or g/cm^3