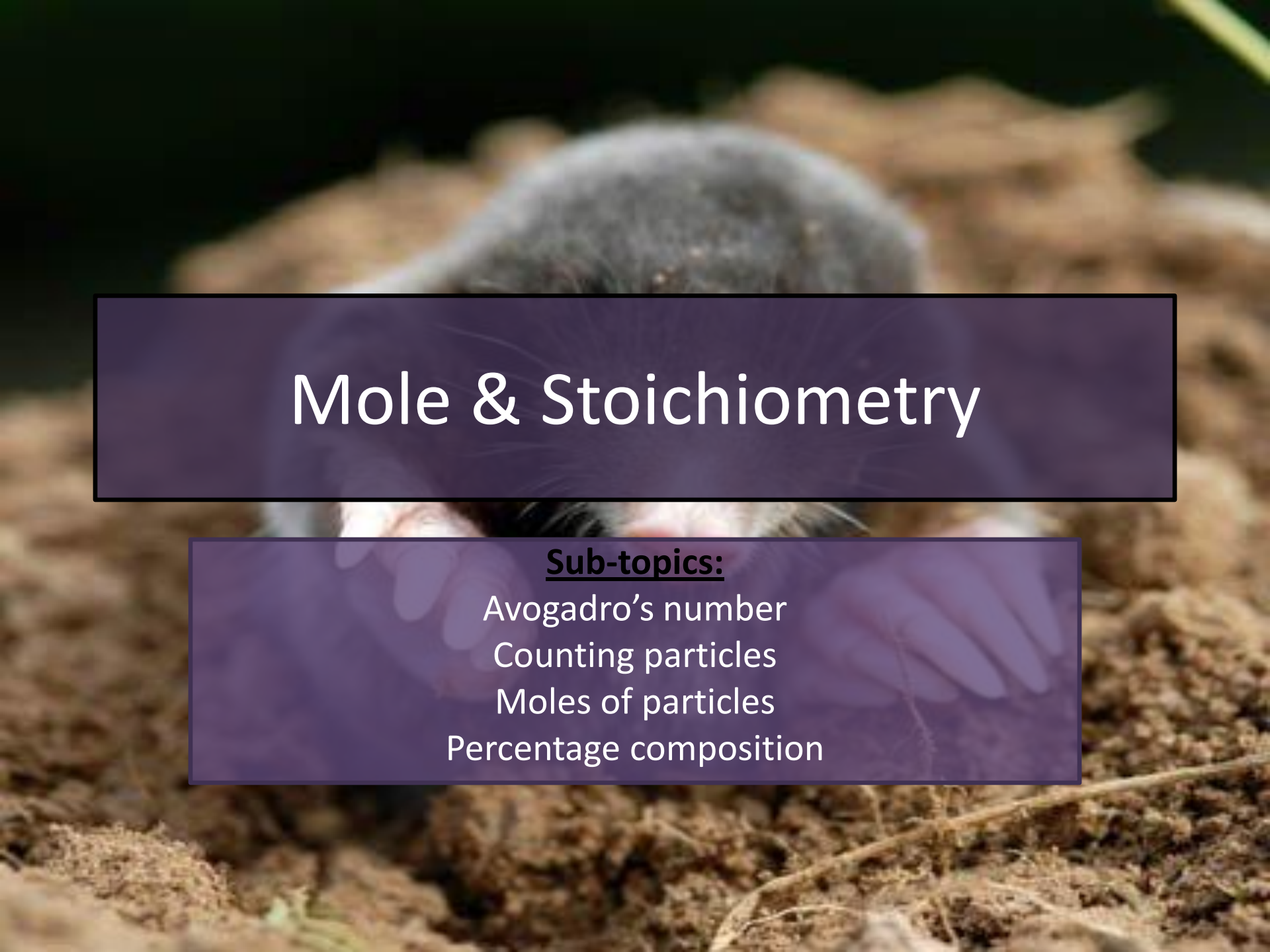


Mole & Stoichiometry

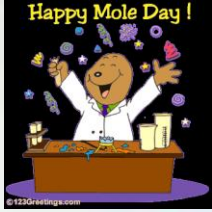
Sub-topics:

Avogadro's number

Counting particles

Moles of particles

Percentage composition



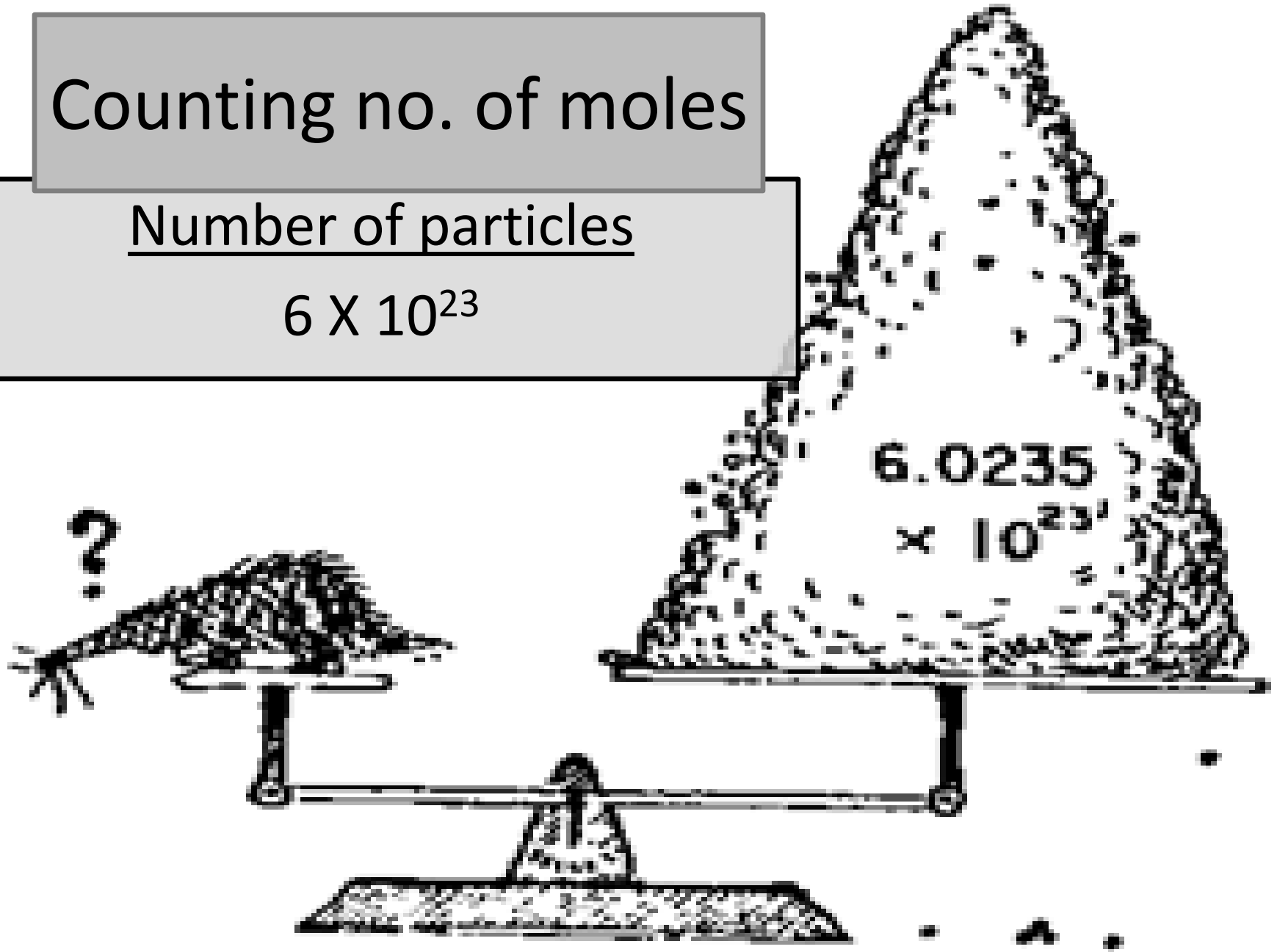
Avogadro's Number

- **6.0×10^{23}**
- Equal to the number of particles of carbon atoms in exactly 12 grams of carbon-12.
- Mole is abbreviated as **mol**.
- It is a **counting unit** used in chemistry to deal with *atoms*, *molecules*, and *ions*.

Counting no. of moles

Number of particles

6×10^{23}



Example 1

- **How many molecules are there in 3 X 10^{23} molecules of water, H_2O?**

Number of moles = $\frac{\text{Number of particles}}{6 \text{ X } 10^{23}}$

$= \frac{3 \text{ X } 10^{23}}{6 \text{ X } 10^{23}}$

$= 5$ mol.

Example 2

- **How many molecules are there in 0.25 mole of carbon dioxide, CO2?**
- **How many atoms are present?**

No. of CO_2 molecules :

Number of moles = Number of particles / 6×10^{23}

Number of particles = No. of moles $\times 6 \times 10^{23}$

$= 0.25 \times 6 \times 10^{23}$

$= 1.5 \times 10^{23}$ molecules.


Percentage Composition

Why use ‘Percentage composition’?

- A compound contains more than one element.
- E.g. Which of the two iron ores (haematite & magnetite) contains the greater percentage of iron? Which will provide the greater mass of iron if the chemist takes the same mass of each compound?
- Haematite = Iron (III) oxide
- Magnetite = Iron (II, III) oxide.
- **Calculate the percentage of iron by mass in each compound.**

Formula

$$\% \text{ of an element} = \frac{(\text{atoms of element}) \times (Ar)}{(Mr \text{ of compound})} \times 100$$

Example 1

- **Calculate the percentage by mass of the element iron (III) oxide.**
- Formula of iron (II) oxide = Fe_2O_3
- Mr of Fe_2O_3 = 2(56) + 3(16) = 112 + 48 = 160

$$\% \text{ of Fe in } Fe_2O_3 = \frac{\text{(atoms of element) X (Ar)}}{\text{(Mr of compound)}} \times 100$$

$$= \frac{2 \times 56}{160} \times 100$$

$$= 70\%$$

Example 2

- **Calculate the mass of copper in 32 g of copper(II) sulphate, $CuSO_4$.**

Mr of $CuSO_4$ = 64 + 32 + 4(16) = 160

$$\text{Mass of Cu} = \frac{1 \times Ar}{Mr \text{ of compound}} \times \text{Mass of sample}$$

$$= \frac{1 \times 64}{160} \times 32 \text{ g}$$

$$= 12.8 \text{ g}$$

Example 3

- **Calculate the mass of water in 12.5 g of hydrated copper(II) sulphate, $CuS0_4.5H_2O$.**

One $CuS0_4.5H_2O$ contains 5 H_20 molecules.

Mass of H2O = $\frac{5 \text{ X Mr of } H_20}{\text{Mr of } CuS0_4.5H_2O}$ X mass of sample

= $\frac{5 \text{ X } 18}{250}$ X 12.5

= 4.5 g