Counting by Weighing & the Mole

I can count by weighing and explain what a mole is and how big 6.02×10^{23} is.

COUNT BY WEIGHING (C8.01)

Things too small or too many to count one by one can be **counted by weighing**.

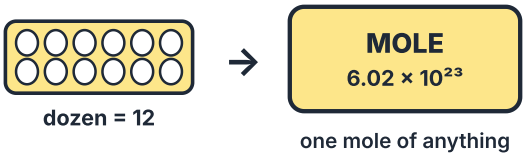
1. Weigh **10** (or 100) items and divide → mass of **one**.
2. Weigh the whole bag.
3. **count = total mass ÷ mass of one**

Beans: 10 beans = 3.8 g → 0.38 g each. Bag = 57.4 g → 57.4 ÷ 0.38 ≈ **150 beans**

Why weigh 10, not 1? One bean is too light for the balance to read well. Weighing many averages out the small differences.

COUNTING UNITS

pair	dozen	ream	mole (mol)
2	12	500	**6.02×10^{23}**



dozen = 12

one mole of anything

Avogadro's number = 6.02×10^{23} = 602,000,000,000,000,000,000,000 (602 sextillion)

HOW BIG IS A MOLE?

- A mole of **seconds** is about 1.4 million times the age of the universe.
- If all **8 billion people** counted, one number a second each, reaching a mole would take about 2.4 million years.
- A mole of **marshmallows** would cover the whole Earth about 17 km deep.

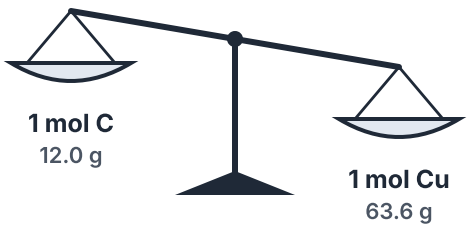
WHAT ARE WE COUNTING?

A mole counts a substance's **representative particle**: the smallest piece that is still that substance.

The substance is…	Its particle	Examples
an element (most)	**atom**	Fe, Cu, C, He
one of the 7 diatomic elements	**molecule**	O_2, N_2, Cl_2
a molecular compound (nonmetals only)	**molecule**	H_2O, CO_2, CH_4
an ionic compound (metal + nonmetal)	**formula unit**	NaCl, MgO, $CaCl_2$

The 7 diatomics: H_2 N_2 O_2 F_2 Cl_2 Br_2 I_2 — "a mole of oxygen" means O_2 molecules.

SAME COUNT, DIFFERENT MASS



Both pans hold **6.02×10^{23} atoms**. Copper is heavier because each copper atom is heavier: the C8.01 beans and washers again.

1 mol water ≈ 18 mL (a tablespoon) · 1 mol C = 12.0 g: big number × tiny particles = an amount you can hold.

WATCH OUT

- A mole of big things isn't "more things": a mole is a **number**, like a dozen.
- NaCl isn't a molecule: ionic compounds are counted in **formula units**.
- 6.02×10^{23}, not 6.02×10^{-23} (the minus sign makes it tiny).