



Chapter 9

Atomic Foundations of Matter

“ Understanding the tiny building blocks that make up everything around us.



Observe



Think



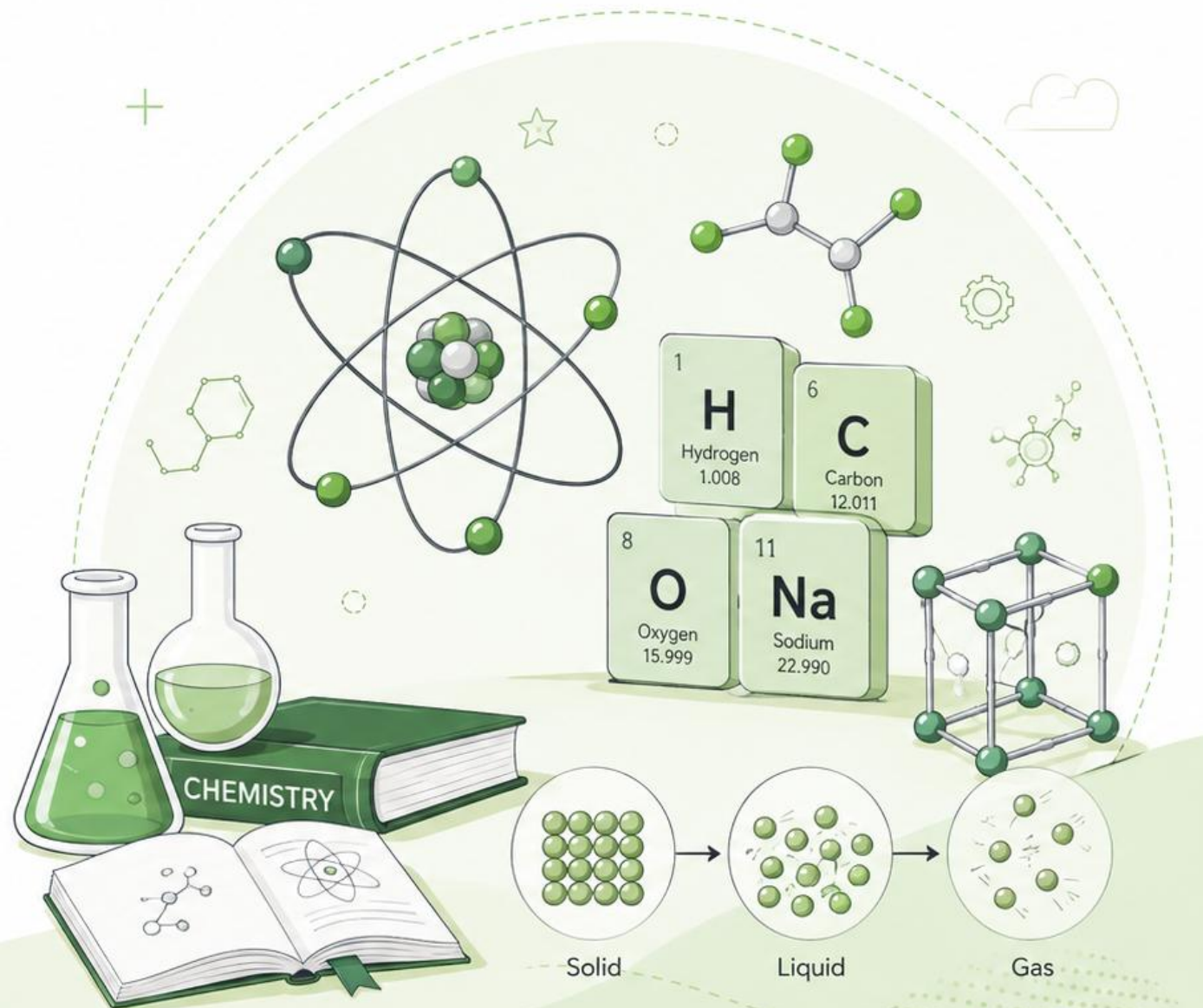
Experiment



Explore

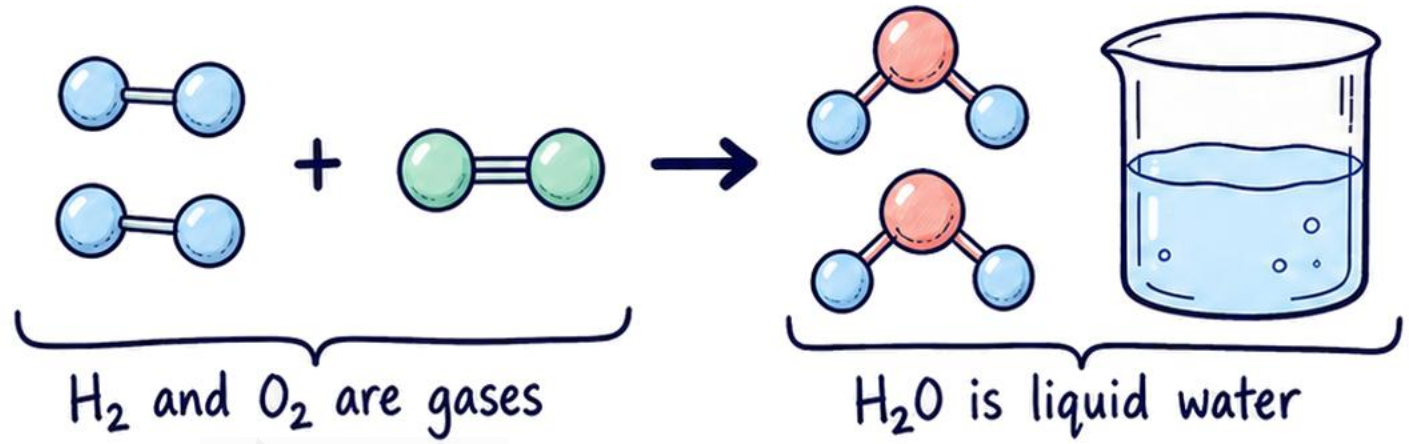


Discover



ATOMIC FOUNDATIONS OF MATTER

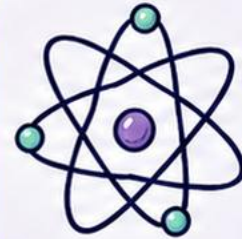
- ★ Atoms rearrange to form compounds.
- ★ A compound can have very different properties from the elements that form it.



WHY DOES
MASS STAY
CONSTANT?



WHY DO
COMPOUNDS HAVE
A FIXED
COMPOSITION?



HOW DO ATOMS
SHARE OR
TRANSFER
ELECTRONS?



ATOMS



MOLECULES / IONS



COMPOUNDS



MEASURABLE
PROPERTIES



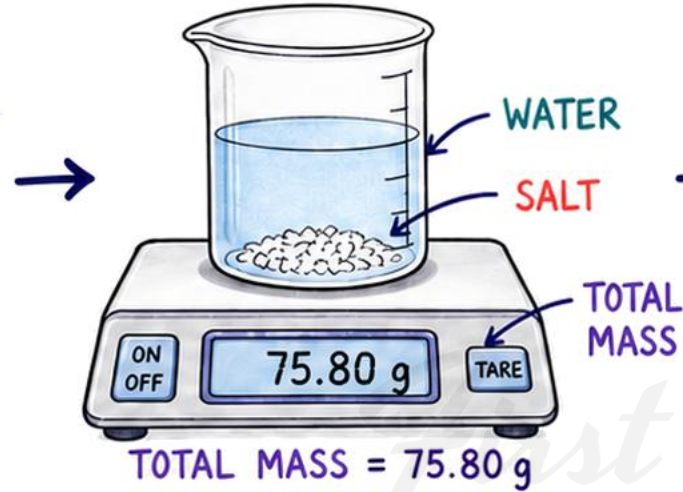
⇒ This chapter links mass laws, atoms, chemical bonds, formulae and compound properties. ⇒

MASS IN A PHYSICAL CHANGE

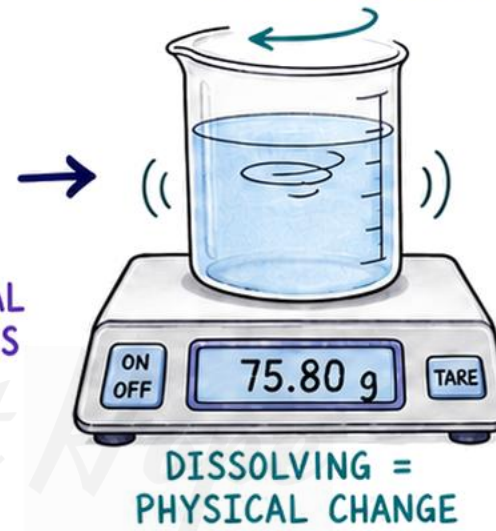
① TARE THE DRY BEAKER



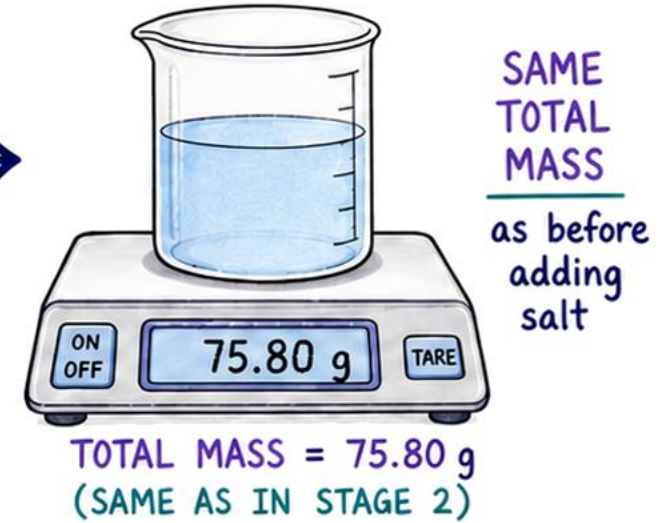
② ADD WATER + SALT



③ SWIRL UNTIL SALT DISSOLVES



④ WEIGH THE SOLUTION AGAIN



$$\text{mass of solution} = \text{mass of water} + \text{mass of salt}$$

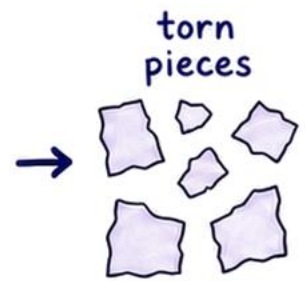
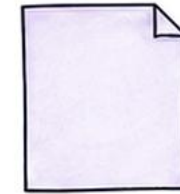
- **MASS** is the amount of matter. It is measured in **grams (g)** and does not change with place.
- **WEIGHT** is the pull of gravity on an object. It is measured in **newtons (N)** and can change with place.

- The salt particles spread through the water.
- Matter has not disappeared.
- The chemical identity of salt and water remains unchanged.

IMPORTANT:

The beaker is open, but no material escapes appreciably during this short test. If water evaporates or spills, only the mass remaining on the balance decreases; matter is not destroyed.

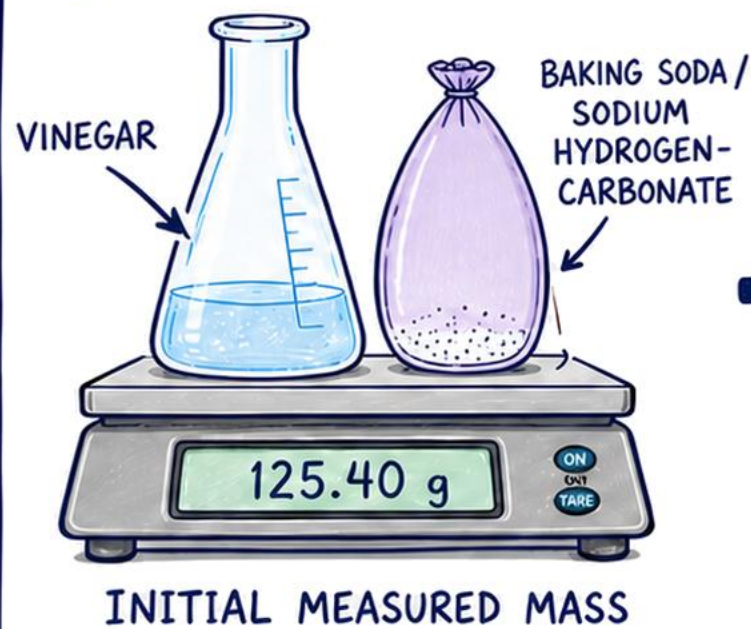
one sheet
of paper



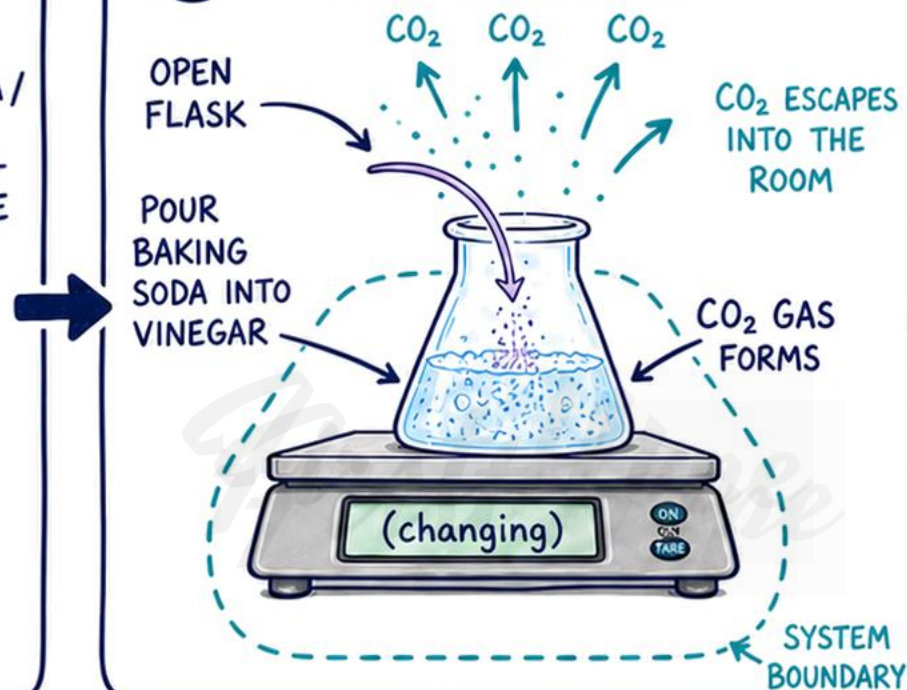
A PHYSICAL CHANGE CHANGES FORM OR ARRANGEMENT, NOT THE TOTAL MASS.

OPEN REACTION: WHY THE MEASURED MASS DROPS

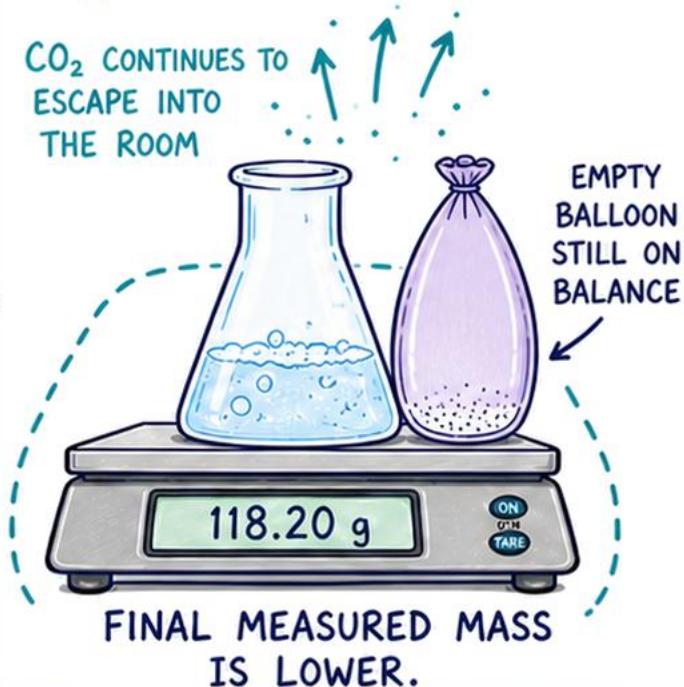
1 BEFORE MIXING



2 REACTION



3 AFTER



vinegar + sodium hydrogencarbonate $\longrightarrow$ carbon dioxide (CO₂) + other substances



The Law of Conservation of Mass is NOT broken.



CO₂ escaped into the room, so the scale no longer measures it.



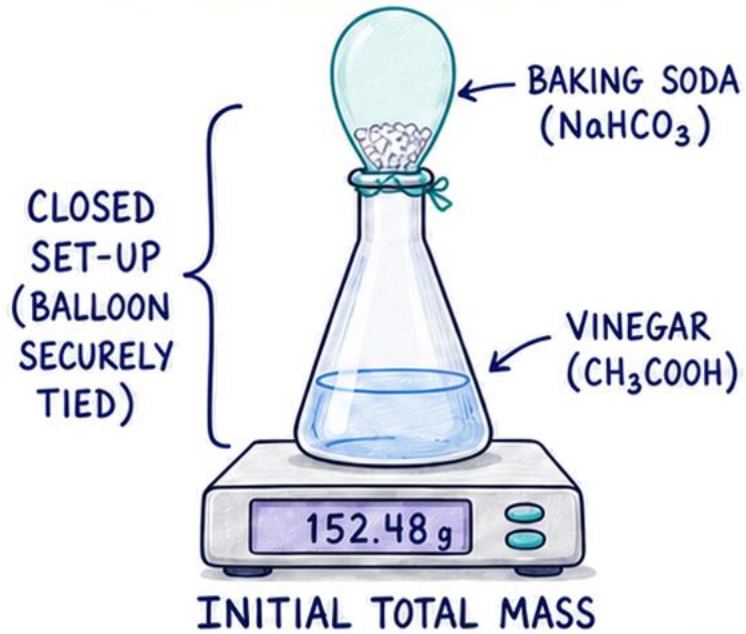
Matter left the measured system; matter was not destroyed.



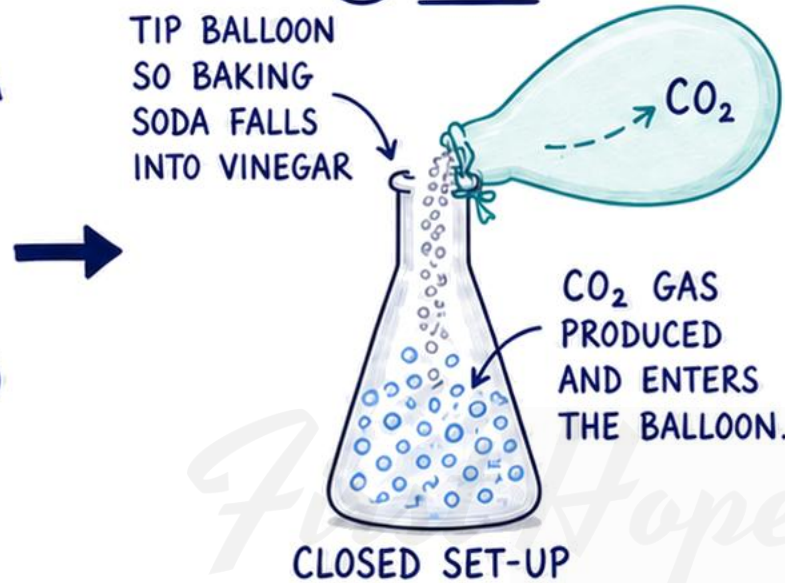
OPEN SYSTEM: PRODUCTS CAN LEAVE THE PART WE ARE WEIGHING.

CLOSED REACTION: MASS IS CONSERVED

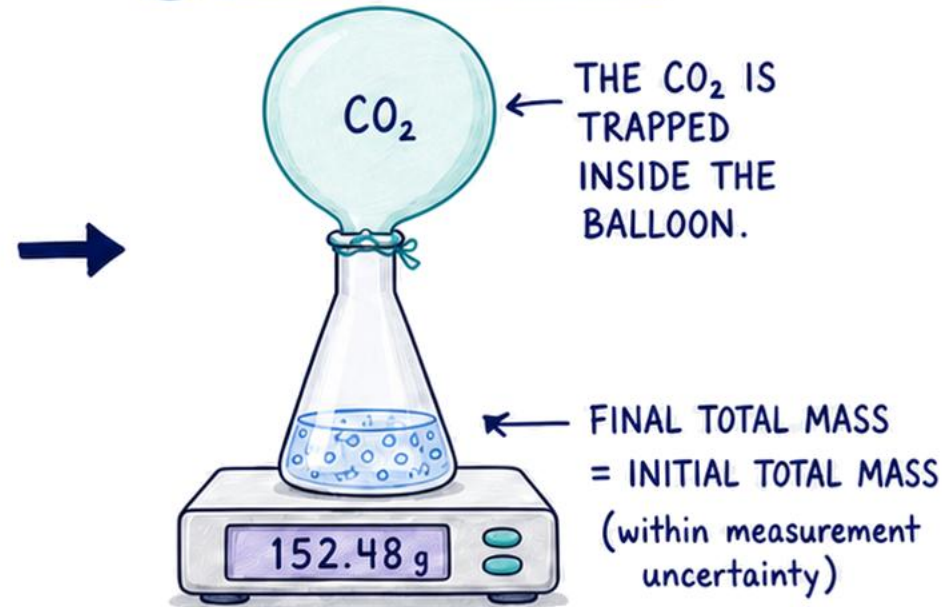
① BEFORE MIXING



② MIX



③ AFTER REACTION



- The CO_2 is trapped inside the balloon.
- All reactants and products remain in the measured system.
- A change of ± 1 in the last displayed digit may be experimental uncertainty.



OPEN SYSTEM:

- gas leaves the measured system
- measured mass decreases
- (law still obeyed; escaped gas is outside the scale)



CLOSED SYSTEM:

- all products are retained
- no gas escapes
- total mass remains constant (within uncertainty)



FOR THE COMPLETE CLOSED SYSTEM, TOTAL MASS BEFORE = TOTAL MASS AFTER.



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