

Why total mass stays the same

Grade 7 science (Year 8 · Class 7) · Lesson

Quick answer: The law of conservation of mass says that the total mass of all substances in a closed system stays the same during any change. Atoms are rearranged but never created or destroyed, so the mass of the starting materials always equals the mass of the final materials.

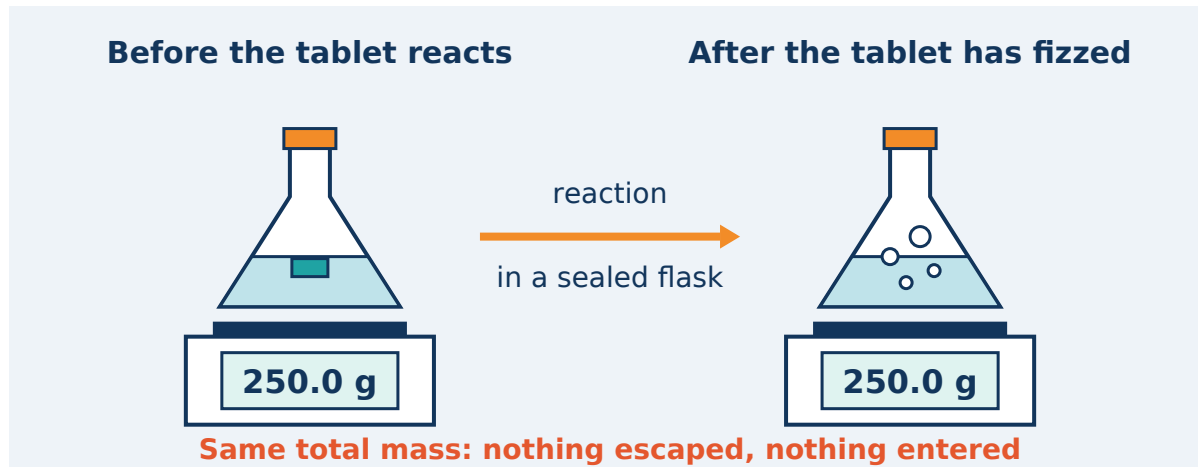
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What is the law of conservation of mass?

When ice melts in a cup, the puddle looks nothing like the cube, yet no matter has gone anywhere. Scientists check this by weighing things before and after a change. In every careful test, with nothing allowed to escape, the numbers match.

Definition

The law of conservation of mass says that, in a closed system, the total mass of all the substances stays constant during a change. Matter is not created or destroyed. It only changes form or moves from one place to another.



A sealed flask on a balance. The tablet reacts and fizzes, but the reading stays 250.0 g because no gas can leave.

A **closed system** is a container where nothing can enter or leave, such as a flask with a tight stopper. In an **open system**, gases can escape into the air or join the mixture from the air.

Does the mass change when something dissolves?

No. When salt dissolves, the crystals break up into particles that spread between the water particles. Every particle is still there, so the mass of the solution is the mass of the salt plus the mass of the water.

Formula

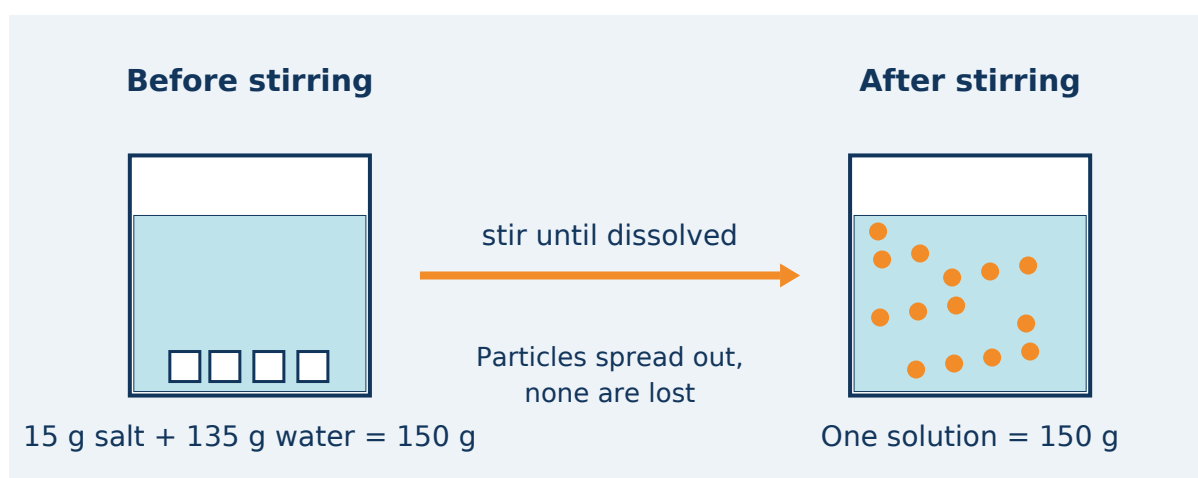
mass of solution = mass of solute + mass of solvent

The solute is the substance that dissolves (g). The solvent is the liquid it dissolves in (g).
The solution is the mixture (g).

Worked example 1

Kofi in Accra stirs 15 g of salt into 135 g of water until every crystal has dissolved.
Calculate the mass of the salt solution.

Mass of solution = 15 g + 135 g = **150 g**. The salt is still there, even though you cannot see it.



Dissolving rearranges the particles but does not remove any. The total mass is 150 g before and after.

Is mass conserved when a substance melts, freezes or reacts?

Yes, as long as the system is closed. Melting, freezing and evaporating only change how close together the particles are. In a chemical reaction, the atoms swap partners to form new substances, but the number of atoms of each element does not change.

Change	Type of change	Total mass in a closed container	Reason
Sugar dissolving	Physical	Unchanged	Particles spread out
Ice melting	Physical	Unchanged	Same particles, more free to move
Water evaporating in a sealed jar	Physical	Unchanged	Vapour stays in the jar
Nail rusting in a sealed jar	Chemical	Unchanged	Oxygen is taken from the air inside
Candle burning in a sealed jar	Chemical	Unchanged	Gases made stay in the jar

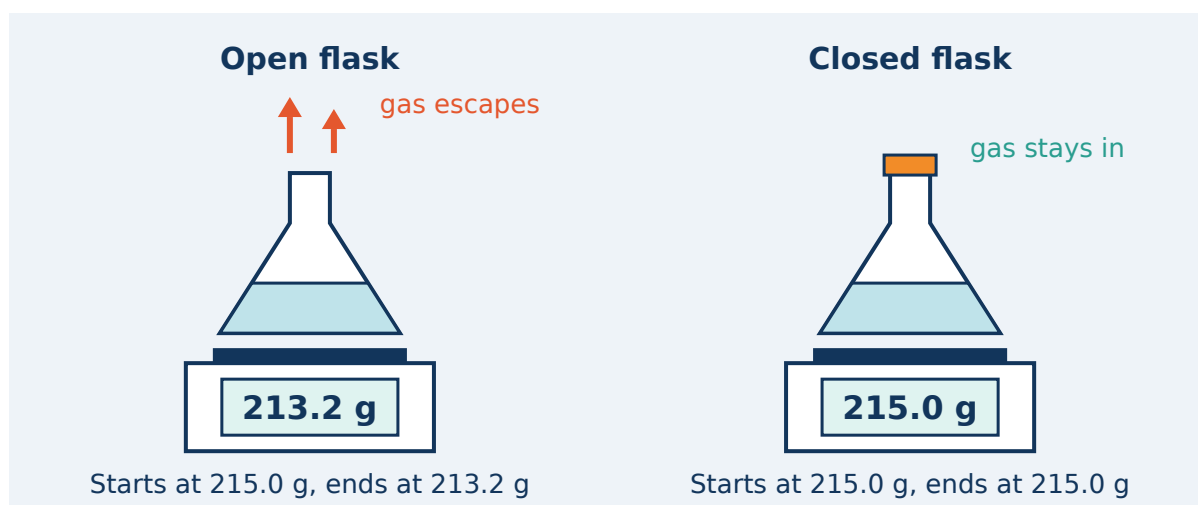
Why does an open container seem to lose mass?

If a reaction makes a gas and the container is open, the gas drifts away and the balance reading falls. The mass has not been destroyed. It has simply left the container, and you stopped weighing it.

Worked example 2

Diego in Texas drops an effervescent tablet into water in an open flask. The flask and contents read 215.0 g before the tablet reacts and 213.2 g after the fizzing stops. Calculate the mass of gas that escaped.

Mass of gas = $215.0\text{ g} - 213.2\text{ g} = 1.8\text{ g}$ of carbon dioxide.



In an open flask the gas escapes and the reading falls. In a closed flask the same gas stays in, so the reading does not change.

Common mistake

Do not say that mass "disappears" when a solid burns or a tablet fizzes. The missing mass is in gases or vapour that you did not weigh. Equally, a rusting nail gets heavier because it takes oxygen from the air.

How do you use conservation of mass in a calculation?

Formula

total mass of reactants = total mass of products

Add up the masses (g) of everything that reacts. The total for everything made must be the same.

Worked example 3

Mei in Singapore burns 6.0 g of magnesium in a closed container with plenty of oxygen. All the magnesium turns into 10.0 g of magnesium oxide. Calculate the mass of oxygen that joined the magnesium.

Mass of oxygen = $10.0\text{ g} - 6.0\text{ g} = 4.0\text{ g}$.

Lina's tip

Before you calculate, ask: is the container closed? If a gas can escape or enter, include its mass in your reasoning. Then write the substances on each side, add them up and compare.

Key points to remember

- Mass of reactants = mass of products in a closed system.
- Dissolving, melting, freezing and evaporating do not change the total mass.
- Mass seems to be lost or gained only when a gas leaves or enters the container.
- Mass of solution = mass of solute + mass of solvent (g).
- Mass is measured in grams (g) or kilograms (kg) on a balance.

Why total mass stays the same: frequently asked questions

What is the law of conservation of mass?

It states that the total mass of the substances in a closed system stays the same during any change. The atoms are rearranged, never created or destroyed.

Why does the mass fall when a tablet fizzes in an open flask?

The fizz is carbon dioxide gas, which leaves the flask and takes its mass with it. In a sealed flask the reading would not change.

Does mass change when ice melts?

No. Melting only changes the spacing and movement of the particles. A 340 g block of ice makes exactly 340 g of water.

Is mass conserved when sugar dissolves in water?

Yes. The sugar particles spread out among the water particles, so the solution has the mass of the sugar plus the mass of the water.

What is a closed system?

A closed system is a container where no matter can enter or leave, such as a flask sealed with a stopper. Energy such as heat can still pass through.