

Substitute Guide: Conservation of Mass in Chemical Reactions

Course: Chemistry (Grades 9–12) **Subject:** Science **Time:** ~50 min standard · ~90 min block Science

Learning goal (plain language)

Students learn the **law of conservation of mass** — that in a chemical reaction **matter is not created or destroyed**, the atoms of the **reactants** are only rearranged into the **products**, so the total mass of reactants equals the total mass of products. They see that this is clearest in a **closed system**, that a gas escaping (or being taken in) in an **open system** only makes mass *seem* to change, and that a **balanced equation** has the same number of atoms of each element on both sides. Working alone with a pencil, students read a short passage, study a labeled particle diagram and a mass-data table, do simple add/subtract calculations, and write an evidence-based explanation (CER). **You do not need a chemistry background to run this.** Everything students need is printed in their packet. This is a **paper** activity — no lab, no materials, no hazards. A **calculator is allowed** but not required.

Standards alignment

Framework: 19 TAC Chapter 112 (Chemistry). Knowledge & skills on **conservation of mass and chemical reactions**.

- **Provisional — conservation of mass:** demonstrate and explain that mass is conserved in a chemical reaction; the total mass of reactants equals the total mass of products because atoms are rearranged, not created or destroyed.
- **Provisional — balancing / interpreting reactions:** interpret and balance simple chemical equations using coefficients so that the number of atoms of each element is equal on both sides of the equation.

Provisional — pending educator verification against the current official TAC source. Specific section number and student-expectation codes are intentionally left unassigned until confirmed.

(Standards are paraphrased here, not quoted. Please confirm the section and wording against your official source. This packet does not claim formal alignment to the TEKS.)

Setup Before class (5 min)

- Count and hand out one **student packet** per student.
- Confirm each student has a **pencil**. A **calculator is allowed** but not needed (the masses add and subtract cleanly). No computers or lab items are required.
- Write the date on the board and remind students to fill in the name line.
- Keep the **answer key** with you — it is a separate file and is **not** in the student packet.

Materials What's needed

- Printed student packet (4–6 pages) per student.
- Pencil per student; a calculator is optional.

- This guide and the separate answer key (teacher only).
- No lab equipment, no chemicals, no safety hazards — this is a paper investigation.

Timing Suggested pacing — standard vs. block

Segment	Standard (~50 min)	Block (~90 min)	What students do
Start — Notice & Wonder	5 min	5 min	Q1–Q2 warm-up
Build — Read the science	8–12 min	12 min	Read passage, word bank, particle diagram; Q3
Apply — Use the data	20–25 min	25 min	Table 1; Q4–Q9 (check conservation, missing mass, open-system gas, atom counts, predict)
Explain — CER	7–10 min	10 min	Q10 explanation (claim/evidence/reasoning)
Close — ACE	5 min	5 min	Articulate / Connect / Extend
Continue — early finishers	optional	+30 min	Design a conservation problem; block adds balancing a simple equation with coefficients

On a **standard ~50-minute** period, the core stops after the CER (Q10) and ACE; the early-finisher problem is optional. On a **~90-minute block**, everyone also completes the block extension — balancing $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$ with coefficients and proving it with an atom-count table.

Script Read aloud to start

"Today's assignment is a paper science investigation called *Conservation of Mass in Chemical Reactions*. You will work by yourself with just a pencil — no computers, and nothing to build or mix. A calculator is allowed if you want one, but the math is simple adding and subtracting. First read the short passage and study the particle diagram and the table of masses. Then answer the questions in order; if one is tricky, skip it and come back. The big idea is that in a chemical reaction, atoms are never created or destroyed — they just rearrange — so the mass of what you start with equals the mass of what you end with. Write in complete sentences where it asks you to explain. You may quietly read the passage aloud to yourself. Put your name, class period, and date at the top now. You have about 50 minutes (or the full block); raise your hand if you need help understanding a word."

Support When students ask for help

- **You may read any part aloud** to a student or the class.
- If they are stuck on "reactants vs. products," point them to the **reference box** and the **reactants** → **products** arrow — reactants are on the left, products on the right.
- For the mass items (Q4–Q6), remind them: reactants total = products total. To find a missing mass, add the knowns or subtract from the total. A calculator is fine.
- For the atom-count item (Q7), remind them a **coefficient** (big number in front) multiplies the whole formula, and a **subscript** (small low number) counts atoms inside it.
- Encourage the printed **sentence stems** for the CER (Q10) and ACE sections.
- Do **not** give answers; prompt with "What does the data show?" or "Where could the missing mass have gone?"
- It is fine if a student cannot finish the optional early-finisher or block task.

Access Accommodations & language support

- **Read-aloud** of any passage or question is allowed for all students.
- Point students to the **sentence stems** and the **Word Bank** (definitions provided).
- Extended time is fine; the core can stop after Q10 if time runs short.
- Students may answer in phrases if writing full sentences is a barrier, as long as the idea is clear. Showing the add/subtract step is enough for Q4–Q6.
- A calculator is permitted for any student who wants one.
- The packet is grayscale-safe — it prints and reads clearly in black and white; the particle diagram uses patterns and labels, not color.

Tools Allowed & not allowed

Allowed: pencil, a calculator, the printed packet, quiet self-read-aloud. **Not needed / not allowed:** phones, computers, lab materials or chemicals.

Collect at the end: Collect every packet, whether finished or not, with names on them. Stack them for the teacher. Note on a sticky how far most students got and any questions that caused confusion.

Answer key: The **answer key is a separate file** ([answerkey.html](#)) and is for the teacher only. Please do not hand it to students.

Teacher follow-up (for the returning teacher)

Watch for two high-value misconceptions: students thinking *mass is created or destroyed* in a reaction, and thinking a gas *has no mass* so an open-system loss "breaks" the law. A quick next-day discussion contrasting a sealed bottle with an open beaker, and tying a balanced equation to equal atoms on both sides, would reinforce this well. The mass calculations (Q4–Q6) and the atom-count balance check (Q7) show who can reason with the data; the CER (Q10) responses show who can cite specific masses as evidence.

HS_CHEM_ConservationMass_01 — Conservation of Mass in Chemical Reactions Substitute Guide

Conservation of Mass in Chemical Reactions

Course: Chemistry (Grades 9–12) **Subject:** Science **Time:** ~50 min standard · ~90 min block **Work mode:** Independent · pencil only Science

Start Here

This is a **paper investigation**. You will study a diagram of a simple chemical reaction, read a short passage, and analyze a data table of masses using a pencil. You do **not** need a computer, a lab, or any materials besides this packet and a pencil. There are **no hazards** — nothing is measured on a real balance, mixed, or heated. Work by yourself and do your best thinking. You will do some arithmetic with masses (adding and subtracting grams); a **calculator is allowed**, but the numbers are chosen so you can do them by hand. Write in complete sentences where you are asked to explain. If a question is hard, skip it, keep going, and come back. Reading the passage quietly aloud to yourself is allowed and encouraged.

Start Notice & Wonder 5 min

Imagine sealing a fizzing tablet and water inside a capped bottle, then weighing the whole bottle before and after it fizzes.

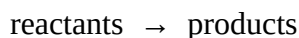
1When wood burns in a campfire, only a small pile of ash is left behind — it looks like most of the wood "disappeared." Write **one thing you notice** and **one thing you wonder** about where the rest of the wood's material went.

2If you sealed a fizzing tablet and water inside a **capped** bottle and weighed the whole bottle before and after it fizzed, do you think the total mass would go **up**, go **down**, or **stay the same**? Give your best first idea and say why.

Build Read the Science 8–12 min

The law of conservation of mass

In a chemical reaction, the starting substances are called **reactants** and the new substances that form are called **products**. We show a reaction with an arrow that means "produces" or "turns into":



The **law of conservation of mass** states that in a chemical reaction, **matter is never created or destroyed**. The atoms in the reactants are only **rearranged** into new combinations in the products. Because no atoms are added or lost, the **total mass of the reactants equals the total mass of the products**:

$$\text{total mass of reactants} = \text{total mass of products}$$

This is only guaranteed to be visible when the reaction happens in a **closed system** — a container that lets **no matter in or out** (like a sealed, capped bottle). In an **open system**, a gas product can **escape** into the air. The mass you can weigh in the container then seems to drop — but the "missing" mass left as gas. The atoms were **conserved**; they just floated away where the balance could not weigh them. Likewise, a reaction that pulls in a gas (such as burning metal combining with oxygen from the air) can seem to **gain** mass in an open container.

Balanced equations. Chemists write reactions as equations using formulas. A **coefficient** is the big number in front of a formula telling how many of that particle take part (for example, the **2** in **2 H₂O** means two water molecules). A **subscript** is the small low number inside a formula telling how many atoms of one element are in a single particle (the small **2** in H₂O means two hydrogen atoms per water molecule). An equation is **balanced** when there is the **same number of atoms of each element on both sides of the arrow**. A balanced equation is conservation of mass written in symbols.

Example — water forming from hydrogen and oxygen: $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$. Left side: 4 H atoms (2 molecules $\times$ 2 H) and 2 O atoms. Right side: 4 H atoms (2 molecules $\times$ 2 H) and 2 O atoms (2 molecules $\times$ 1 O). The atoms match on both sides, so it is balanced — the atoms were only rearranged.

Word Bank

reactant

a starting substance in a chemical reaction (written to the left of the arrow).

product

a new substance formed by a chemical reaction (written to the right of the arrow).

coefficient

the number in front of a formula that tells how many of that particle react (the 2 in $2 \text{H}_2\text{O}$).

conserved

kept the same total; not created or destroyed (atoms and total mass are conserved).

closed system

a container that lets no matter in or out, so all products stay and can be weighed.

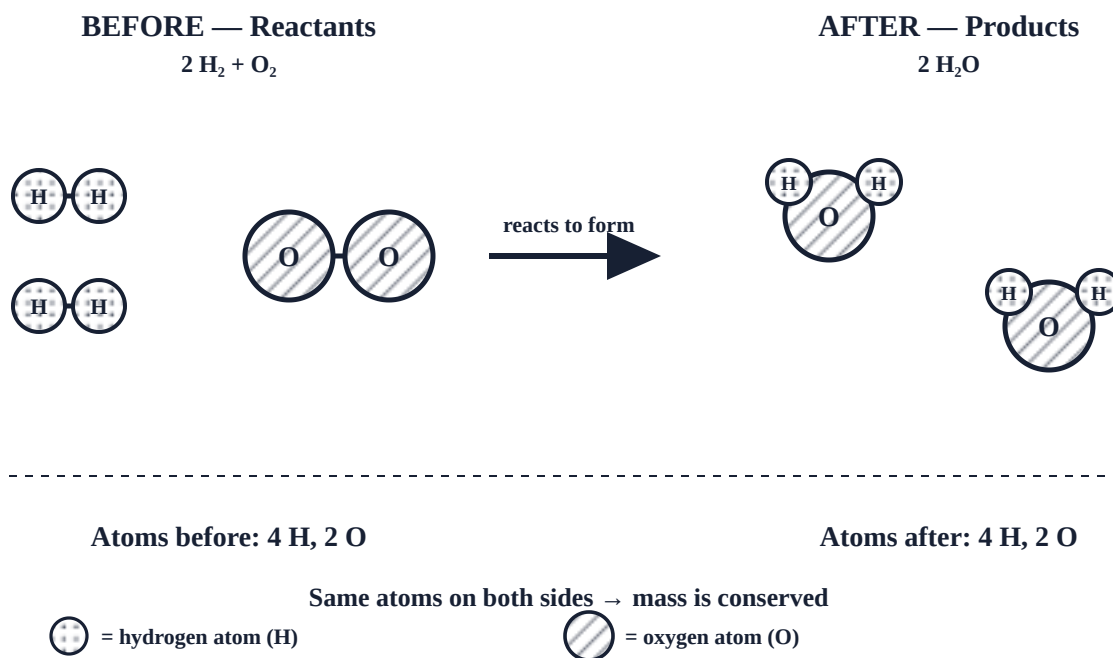


Figure 1. Particle diagram of $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$. **Before** the arrow: two hydrogen molecules (dotted) and one oxygen molecule (hatched) — **4 H and 2 O atoms**. **After** the arrow: two water molecules — still **4 H and 2 O atoms**. The atoms are only **rearranged** into new molecules; none are created or destroyed, so mass is **conserved**. Patterns and labels — not color — carry the meaning, so the figure reads clearly in grayscale.

3Using Figure 1, count and record the number of **hydrogen (H)** atoms and **oxygen (O)** atoms on the **before** side and on the **after** side. In one sentence, state whether the atoms were conserved and how the diagram shows it.

Apply Use the Data 20–25 min

Table 1 gives the measured masses (in grams) for three reactions. Two happen in a **closed** system (sealed flask); one happens in an **open** beaker where a gas can escape. Study it, then answer. (These are original numbers for this packet.)

Table 1. Masses of reactants and products for three reactions (grams). A dash (—) means the value was not recorded. (Original data.)

Reaction	System	Reactant A (g)	Reactant B (g)	Product(s) recovered (g)
1	Closed (sealed flask)	12.0	8.0	20.0
2	Closed (sealed flask)	15.0	—	40.0
3	Open (beaker, gas escapes)	50.0	0.0	34.0 (solid left in beaker)

4Check conservation (closed system). For **Reaction 1**, add the two reactant masses and compare the total with the product mass recovered. Show your work. Was mass conserved? Explain in one sentence how you can tell.

5Find the missing mass. In **Reaction 2** (a closed system), the mass of **Reactant B** was not recorded. Use the law of conservation of mass to find it. Show your work.

5a. Write the conservation equation in words: mass of A + mass of B = total mass of products.

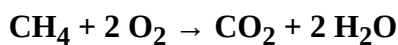
5b. Substitute the known masses and solve for the mass of Reactant B. Show the subtraction.

6Explain the open system. In **Reaction 3**, 50.0 g of solid reactant was heated in an **open** beaker, and only 34.0 g of solid was left afterward. A student says, "Mass was destroyed — the law is broken."

6a. Calculate how many grams "went missing" from the beaker. Show your work.

6b. Explain what really happened to that mass and why the law of conservation of mass was **not** broken. Use the word **gas** in your answer.

7Count atoms to check a balance. Look at the equation below. Count the atoms of each element on each side and decide whether it is **balanced** (same number of each element on both sides).



Fill in the atom counts:

Element	Atoms on LEFT (reactants)	Atoms on RIGHT (products)	Balanced? (yes/no)
Carbon (C)			
Hydrogen (H)			
Oxygen (O)			

Is the whole equation balanced? Circle: **YES** / **NO**

8Observation vs. inference. Write **O** if the statement is an observation (a value read directly from Table 1) or **I** if it is an inference (a conclusion you reason out).

___ a) In Reaction 3, 34.0 g of solid was left in the beaker.

___ b) In Reaction 3, 16.0 g of gas escaped into the air.

___ c) In Reaction 1, the recovered product mass was 20.0 g.

___ d) Reaction 2 must have taken in 25.0 g of Reactant B for mass to be conserved.

9Closed vs. open — which is fair? In 2–3 sentences, explain why a **closed system** is the fair way to test whether mass is conserved, and why an **open system** can fool you into thinking mass was lost or gained. Use the

words **reactant**, **product**, and **gas**.

Explain Claim–Evidence–Reasoning 7–10 min

Question 10. A student combines the two reactants of **Reaction 1** inside a sealed flask and measures 20.0 g of product. Using the data in Table 1, write a **claim** answering *whether mass was conserved in Reaction 1*, support it with **two pieces of evidence** (specific masses from Table 1), then explain your **reasoning** using the law of conservation of mass and the idea of atoms being rearranged.

Sentence stems you may use: "Mass was / was not conserved in Reaction 1 because..." · "One piece of evidence is... (from Table 1)." · "A second piece of evidence is..." · "This shows mass was conserved because the atoms were..."

Claim

Evidence (two pieces, with masses)

Reasoning

Close ACE Wrap-Up 5 min

Articulate

Explain the **law of conservation of mass** in your own words, as if teaching a friend.

Connect

Point to one row of Table 1 that shows mass being conserved (or seeming to change). Name the numbers.

Extend

Give a **new** everyday example (not in this packet) where a gas escaping or being taken in makes mass *seem* to change, and say what really happens to the atoms.

Continue Early Finisher & Block Extension optional · block ~+30 min

If you finish early (no new materials needed):

Design your own conservation problem. On the back of this page, invent a reaction in a sealed flask. Choose masses for two reactants and one product so that mass is conserved, but leave **one** mass blank. Write the words "reactants → products," then trade the missing value with an imaginary partner and show how the law of conservation of mass lets you solve for the blank.

Block-period extension — balance a simple equation with coefficients:

The equation for hydrogen gas burning to form water is $__ \text{H}_2 + __ \text{O}_2 \rightarrow __ \text{H}_2\text{O}$. It is not balanced yet. Fill in whole-number **coefficients** (the big numbers in front) so the equation has the **same number of H atoms and the same number of O atoms on both sides**. Make a small atom-count table for H and O to prove your answer is balanced. Then, in one sentence, explain how a balanced equation is another way of showing the law of conservation of mass.

Turn in: Hand in this whole packet with your name, class period, and date filled in. Make sure questions 1–10 and the ACE box are answered. The early-finisher problem and the block-period balancing task are optional but turn them in too if you did them.

HS_CHEM_ConservationMass_01 — Conservation of Mass in Chemical Reactions Student Packet



TEACHER ANSWER KEY FOLLOWS

Do not copy the pages after this divider for students.

Answer Key: Conservation of Mass in Chemical Reactions

Course: Chemistry (Grades 9–12) **Subject:** Science **For teacher use only** Science

How to use this key

Answers are grouped by section and question number. Many items are open-ended; accept any response that shows correct reasoning even if the wording differs. The mass calculations are worked out in full. Notes flag where more than one answer is defensible and list common misconceptions to watch for. A calculator is allowed but not required — all values divide and subtract cleanly. Estimated grading time: ~6–8 min per packet.

Start Notice & Wonder grade for effort · ~2 min

1 Where did the burned wood's material go?

Full credit for any reasonable notice + wonder. **Ideal:** Notice — "there is much less material left than the wood we started with." Wonder — "did the missing material turn into smoke or gas?" Accept any on-topic wonder. *Science note (not required from students):* the wood's atoms combined with oxygen and left as invisible gases (carbon dioxide and water vapor) plus smoke; mass was conserved, just not all left behind as ash.

2 Capped bottle before vs. after fizzing.

Accept any reasonable prior idea. **Target idea:** the total mass **stays the same**, because the bottle is **closed** — the gas (carbon dioxide) that forms is trapped inside, so no matter leaves. Do not penalize incorrect prior knowledge here — this is a warm-up. (A student who predicts a change is often revealing the "gas has no mass" or "open-system loss" misconception; note it for Q6/Q9.)

Build Read the Science ~1 min

3 Atom counts from Figure 1; were atoms conserved?

Before: 4 H atoms and 2 O atoms ($2\text{H}_2 = 4\text{H}$; $\text{O}_2 = 2\text{O}$). **After:** 4 H atoms and 2 O atoms ($2\text{H}_2\text{O} = 4\text{H}$ and 2 O). **Yes — atoms were conserved:** the same numbers of H and O appear on both sides; the atoms were only rearranged from H_2 and O_2 molecules into H_2O molecules. Since the same atoms are present, the total mass is unchanged.

Apply Use the Data ~3 min

4 Check conservation in Reaction 1 (worked).

Reactants: $12.0\text{ g} + 8.0\text{ g} = 20.0\text{ g}$. Product recovered = **20.0 g**. Since $20.0\text{ g} = 20.0\text{ g}$, **mass was conserved**. You can tell because the total mass of the reactants equals the total mass of the products — no mass was gained or lost in the sealed (closed) flask.

5 Find the missing mass, Reaction 2 (worked).

5a. mass of A + mass of B = total mass of products.

5b. $15.0\text{ g} + (\text{mass of B}) = 40.0\text{ g} \rightarrow \text{mass of B} = 40.0\text{ g} - 15.0\text{ g} = \mathbf{25.0\text{ g}}$. Reactant B had a mass of **25.0 g**. (Closed system, so all product mass came from the reactants.)

6 Explain the open system, Reaction 3 (worked).

6a. Missing mass = $50.0\text{ g} - 34.0\text{ g} = \mathbf{16.0\text{ g}}$.

6b. The 16.0 g was **not destroyed**. In this **open** beaker a **gas** product formed and escaped into the air, carrying those 16.0 g away where the balance could not weigh them. If the reaction had been done in a **closed** container, the trapped gas would have been weighed and the total would still be 50.0 g. The law of conservation of mass holds — the atoms left as gas rather than being destroyed. *Full credit for identifying escaping gas as the missing mass and stating the law is not broken.*

7 Count atoms to check the balance: $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$.

Element	Left (reactants)	Right (products)	Balanced?
Carbon (C)	1 (in CH_4)	1 (in CO_2)	yes
Hydrogen (H)	4 (in CH_4)	4 (2×2 in $2\text{H}_2\text{O}$)	yes
Oxygen (O)	4 (2×2 in 2O_2)	4 (2 in CO_2 + 2 in $2\text{H}_2\text{O}$)	yes

Every element matches on both sides, so the whole equation **IS balanced** — **circle YES**. (This is the combustion of methane; students do not need to name it.)

8 Observation (O) vs. Inference (I).

a) **O** — a value read directly from Table 1 (34.0 g solid left).

b) **I** — the 16.0 g of escaped gas is not a recorded value; it is reasoned out ($50.0 - 34.0$) using conservation of mass.

c) **O** — a value read directly (20.0 g product).

d) **I** — a conclusion reasoned from the law (25.0 g of B is calculated, not measured; the table shows a dash). *Observation = measured/read directly; inference = a conclusion reasoned from evidence.*

9 Closed vs. open — which is fair?

Full credit if the student explains that a **closed system** traps every **product** — including any **gas** — so the balance weighs all the matter that came from the **reactants**, letting you fairly test that reactant mass = product mass. In an **open** system a gas product can escape (mass seems to drop) or a gas can be pulled in from the air (mass seems to rise), so the weighing fools you even though atoms are conserved. **Model:** "A closed system is fair because no gas can leave or enter, so all the products stay to be weighed and equal the reactants. An open system can fool you because a gas product escapes (or gas is taken in), changing the weight on the balance even though no atoms were created or destroyed." Accept equivalent wording.

Explain CER (Q10) ~2 min

10 Was mass conserved in Reaction 1?

Model answer. Claim: Mass **was conserved** in Reaction 1. Evidence: (1) The two reactants had masses of 12.0 g and 8.0 g, a total of 20.0 g. (2) The product recovered from the sealed flask had a mass of 20.0 g. Reasoning: By the law of conservation of mass, matter is not created or destroyed in a reaction — the atoms of the reactants are only rearranged into the product. Because the flask was a closed system, no matter left or entered, so the total mass of the products (20.0 g) equals the total mass of the reactants ($12.0 + 8.0 = 20.0\text{ g}$), which is exactly what the data show.

Defensible alternates: A student may cite the closed-system condition as a piece of evidence, or contrast

Reaction 1 with the open Reaction 3. Accept any claim of "conserved" supported by two correct numeric mass values and sound conservation-of-mass reasoning. A claim of "not conserved" is **incorrect** for Reaction 1 (the masses are equal) and should not earn full credit.

CER scoring rubric (3 points)

Score	Claim	Evidence	Reasoning
3	Clear, correct claim: mass was conserved in Reaction 1.	Two accurate mass values from Table 1 (e.g., 12.0 + 8.0 g reactants and 20.0 g product).	Correctly uses conservation of mass / rearranged atoms and the closed system to explain why reactant mass = product mass.
2	Correct claim stated, mostly clear.	One solid mass value, or two with a minor error.	Some correct linkage but incomplete or a small misconception.
1	Vague or partly correct claim.	Evidence weak, non-numeric, or not from the table.	Little or flawed reasoning; law not correctly applied.
0	No claim, or an incorrect "not conserved" claim.	No evidence.	No reasoning.

Close ACE ~1 min

ACE Articulate / Connect / Extend.

Articulate: accept any accurate plain-language statement (e.g., "in a reaction, atoms are not created or destroyed — they just rearrange, so the total mass of the products equals the total mass of the reactants").

Connect: the cited row must show conservation or an apparent change, e.g., Reaction 1: 12.0 + 8.0 g = 20.0 g product (conserved), or Reaction 3: 50.0 g → 34.0 g solid (16.0 g left as gas).

Extend: any correct new example, e.g., a rusting nail gains mass because iron takes in oxygen gas from the air; a fizzing open soda loses mass because carbon dioxide gas escapes; a burning candle in open air seems to lose mass but the atoms leave as gases. More than one answer is defensible; the key is that atoms are conserved and only the weighable mass changed.

Extend Early finisher & block extension (optional)

EF Design your own conservation problem.

Reward a sealed-flask reaction where the chosen masses obey reactants = products (for example 10 g + 5 g → 15 g) with exactly one value left blank that can be recovered by adding or subtracting. The solution must use the law of conservation of mass correctly to fill the blank.

Block Balance $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$ with coefficients (worked).

Balanced equation: $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$ (coefficients 2, 1, 2).

Element Left Right

H $2 \times 2 = 4$ $2 \times 2 = 4$

O $1 \times 2 = 2$ $2 \times 1 = 2$

H: 4 = 4 and O: 2 = 2, so the equation is balanced. *Accept any equivalent whole-number multiple written in lowest terms (2, 1, 2 is the standard lowest-terms answer; $4 \text{H}_2 + 2 \text{O}_2 \rightarrow 4 \text{H}_2\text{O}$ is balanced but not lowest terms — note this if it appears).* A balanced equation shows conservation of mass because the same number of atoms of each element appears on both sides, so the reactant mass equals the product mass.

Watch Common misconceptions

- **"Mass (or matter) is created or destroyed in a reaction."** Atoms are never created or destroyed — they are only **rearranged**. New substances form, but the same atoms are present before and after, so the total mass is unchanged.
- **"Gases have no mass / don't count."** Gases have mass just like solids and liquids. In Reaction 3 the "missing" 16.0 g is the mass of the escaped **gas**. Watch for students who ignore gas when checking conservation.
- **"An open-system mass loss (or gain) breaks the law."** The law still holds; the container simply cannot weigh matter that has left as gas (mass seems to drop) or been pulled in from the air (mass seems to rise). A closed system reveals the true conservation.
- **Confusing coefficients and subscripts (Q7, Block).** A **coefficient** (big number in front) multiplies the whole particle; a **subscript** (small low number) counts atoms inside one particle. In $2 \text{ H}_2\text{O}$ the atoms are $2 \times 2 = 4 \text{ H}$ and $2 \times 1 = 2 \text{ O}$.
- **Observation vs. inference (Q8).** Students often mark a *calculated* value (escaped gas, missing reactant) as an "observation." If a number is reasoned out with the law rather than read from the table, it is an inference.

Teacher follow-up based on likely errors

If many students say mass was destroyed in the open beaker (Reaction 3), do a quick 5-minute discussion contrasting a sealed bottle with an open one and point to the escaped gas. If the missing-mass subtraction in Q5 is shaky, model reactants = products aloud with units. If Q7 atom counts are off, review that a coefficient multiplies the whole formula while a subscript counts atoms inside it. If CER (Q10) evidence is non-numeric, model citing the $12.0 + 8.0 = 20.0 \text{ g}$ contrast. The "mass is destroyed" and "gas has no mass" misconceptions are the highest-value items to address next class.