

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.

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