

Balancing Chemical Equations – Year 9 (30 minutes)

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Overview

Short, teacher-led lesson using the Classical I-do / We-do / You-do model to teach balancing chemical equations. Emphasis on the conservation of mass and the use of coefficients to balance atoms on both sides of a chemical equation. Low-materials, high-impact activities with embedded pulse checks and a 10-item quiz-style checkpoint list for formative assessment.

Standards alignment (Australian context)

- Understand the conservation of mass in chemical reactions (ACSSU149 / Year 9 Science - Chemical reactions and conservation of mass equivalent).
- Use chemical symbols and formulae to represent substances and write simple chemical equations.
- Balance simple chemical equations using whole-number coefficients.

Learning objectives

Students will be able to:

- Explain the conservation of mass in one clear sentence.
- Use coefficients to balance simple chemical equations, achieving equal numbers of each atom on both sides.
- Apply a step-by-step balancing strategy independently.

Success criteria (lesson-level):

- Correctly balance at least 8 of 10 short equations in the checkpoint quiz using smallest whole-number coefficients.
- Articulate the conservation of mass in the context of a chemical reaction in one sentence.

Materials (low)

- Whiteboard or blackboard and marker/chalk
- Student mini-whiteboards or paper and pencil
- Printed worksheet or displayed list of practice equations (teacher-written)
- Periodic table poster or reference (optional)

Lesson timeline (30 minutes)

1. Warm-up / Hook (3 minutes)

- Quick recap: atoms are conserved in reactions; coefficients change amounts, subscripts change identity.
- Pose a one-sentence prompt: "What must be true about the total number of each type of atom in a chemical reaction?" Collect one or two student answers.

2. I-do – Teacher modeling (7 minutes)

- Model a consistent 5-step balancing process aloud (think-aloud):
 1. Write correct formulas for reactants and products.
 2. Count atoms for each element on both sides.
 3. Pick an element to balance (usually metals first, then non-metals, H and O last).
 4. Add smallest whole-number coefficients to balance counts.
 5. Re-count to verify; simplify coefficients if needed.
- Demonstrate with 2 examples, verbalizing each step:
Example A: $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$ (model balancing to $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$)
Example B: $\text{Fe} + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3$ (model balancing to $4 \text{Fe} + 3 \text{O}_2 \rightarrow 2 \text{Fe}_2\text{O}_3$)

3. Pulse Check 1 (1 minute)

- Task: On mini-whiteboard, balance this equation: $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- Success criteria: Student writes coefficients 1,1,1 (or omits 1s but shows CO_2 correctly balanced). Teacher scans answers; $\geq 75\%$ correct moves on.

4. We-do – Guided practice (8 minutes)

- Co-construct solutions with the class using 3 progressively harder equations. Teacher asks targeted questions and elicits steps; students respond on mini-whiteboards or aloud.

Equations (class works through):

1. $\text{Na} + \text{Cl}_2 \rightarrow \text{NaCl}$
2. $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$
3. $\text{KClO}_3 \rightarrow \text{KCl} + \text{O}_2$

- Use the 5-step process each time, explicitly asking which element to balance first and why.

5. Pulse Check 2 (2 minutes)

- Task: Balance this reaction independently and hold up your answer: $\text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$

- Success criteria: Student writes coefficients $4 \text{ Al} + 3 \text{ O}_2 \rightarrow 2 \text{ Al}_2\text{O}_3$; $\geq 70\%$ correct to continue to independent practice.

6. You-do – Independent practice (6 minutes)

- Students complete 4 short equations from the worksheet individually. Teacher circulates and provides quick feedback.
- Equations for independent practice (choose from the provided quiz-style list).

7. Pulse Check 3 / Exit ticket + Metacognition (3 minutes)

- Exit ticket (1–2 sentences):
 - Write one real-world example where balancing equations (conservation of mass) matters (e.g., combustion engines, pharmaceuticals, recipe scaling) and one sentence describing how you balanced equations today (strategy).
- Success criteria: Student provides a real-world connection and lists at least two steps of the balancing strategy.

Embedded pulse checks (explicit)

- Pulse Check 1 (after I-do): Balance $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$. Success: correct balanced equation (CO_2 shown as product and counts equal). Target class success $\geq 75\%$.
- Pulse Check 2 (after we-do): Balance $\text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$. Success: coefficients 4,3,2; target $\geq 70\%$ correct.
- Pulse Check 3 (exit): One real-world application + description of steps used. Success: includes a valid real-world example and lists at least two strategy steps.

10 Quiz-style checkpoints (short questions for assessment)

Each item: question, correct answer, success criteria (how to judge correctness).

1. Question: Balance $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$

- Correct answer: $2 \text{ H}_2 + \text{O}_2 \rightarrow 2 \text{ H}_2\text{O}$
- Success criteria: Coefficients 2,1,2 (or simplest whole-number equivalent); H and O atoms equal on both sides.

2. Question: Balance $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$

- Correct answer: $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$

- Success criteria: No coefficient change needed; counts equal.
3. Question: Balance $\text{Na} + \text{Cl}_2 \rightarrow \text{NaCl}$
- Correct answer: $2 \text{Na} + \text{Cl}_2 \rightarrow 2 \text{NaCl}$
 - Success criteria: Coefficients 2,1,2; Na and Cl atoms equal.
4. Question: Balance $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$
- Correct answer: $\text{N}_2 + 3 \text{H}_2 \rightarrow 2 \text{NH}_3$
 - Success criteria: Coefficients 1,3,2; N and H atoms equal.
5. Question: Balance $\text{Fe} + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3$
- Correct answer: $4 \text{Fe} + 3 \text{O}_2 \rightarrow 2 \text{Fe}_2\text{O}_3$
 - Success criteria: Coefficients 4,3,2; Fe and O equal.
6. Question: Balance $\text{KClO}_3 \rightarrow \text{KCl} + \text{O}_2$
- Correct answer: $2 \text{KClO}_3 \rightarrow 2 \text{KCl} + 3 \text{O}_2$
 - Success criteria: Coefficients 2,2,3; counts for K, Cl, O balanced.
7. Question: Balance $\text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$
- Correct answer: $4 \text{Al} + 3 \text{O}_2 \rightarrow 2 \text{Al}_2\text{O}_3$
 - Success criteria: Coefficients 4,3,2; check Al and O atoms.
8. Question: Balance $\text{Mg} + \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
- Correct answer: $\text{Mg} + 2 \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
 - Success criteria: Coefficients 1,2,1,1; Mg, Cl, H balanced.
9. Question: Balance $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ (combustion)
- Correct answer: $\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$
 - Success criteria: Coefficients 1,2,1,2; C, H, O balanced.
10. Question: Identify error and correct it: Given equation $2 \text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$ (is this balanced? If not, correct it.)

- Correct answer: Not balanced; correct is $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$
- Success criteria: Student identifies imbalance in O and supplies corrected coefficients.

Use these as written short-answer or multiple-choice where students supply coefficients. Mastery target: 8/10 correct for proficiency.

Differentiation

- Support (struggling learners):
 - Provide step-by-step scaffold sheet listing the 5 balancing steps with a worked example.
 - Allow pairing with teacher-guided mini-sessions during independent practice (brief 1-on-1).
 - Use only 2–3 element equations initially.
- Extension (advanced learners):
 - Provide equations with polyatomic ions treated as units (e.g., $\text{Ca}(\text{OH})_2 + \text{H}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + \text{H}_2\text{O}$) and ask to balance.
 - Introduce fractional coefficients temporarily and then require conversion to smallest whole numbers.

Formative assessment and evidence

- Teacher observation during I-do and We-do; tally correct/incorrect pulse-check responses.
- Collect independent practice answers and exit tickets. Use quiz checkpoint results to determine mastery ($\geq 8/10$).
- Use exit-ticket metacognition to assess ability to transfer concept to a real-world context.

Classroom management and pacing tips

- Use timers for mini-tasks to keep pacing tight (I-do 7 min, We-do 8 min, You-do 6 min).
- Require mini-whiteboards for quick visual checks to expedite feedback.
- If many students struggle on pulse checks, extend guided practice by 2–3 minutes and reduce independent items.

Metacognition prompts (ask students to write 1–2 sentences)

- How did balancing chemical equations today apply outside class? Provide one specific

example (e.g., fuel combustion in engines, designing medication reactions, waste treatment).

- Which two steps of the balancing strategy helped you the most and why?
- What was one mistake you made during practice, and how will you avoid it next time?