Family edition

Reaction Lab: The Equation That Lies

Ages 11-14 · about 45 minutes, in one sitting

Your child runs chemical equations in Reaction Lab and sees what an unbalanced one really claims: atoms that vanish or come from nowhere. Then they balance it and solve short puzzles about atoms and mass.

What you need

- A computer or Chromebook with a current browser.
- The lesson link: mytekdev.com/try/reactionlab?lesson=the-equation-that-lies&ref=fam-reactionlab-2. No account, no email and nothing to install.

Before you start: try it once yourself

Open mytekdev.com/try/reactionlab?lesson=the-equation-that-lies&ref=fam-reactionlab-2. A short guide opens over the app on Burning methane with one of each molecule: $CH_4 + O_2 \rightarrow CO_2 + H_2O$, not balanced.

1. **Run it unbalanced.** Press `React`. The atoms with no place fade out with a red ring, atoms needed from nowhere pop in with an amber ring, and the scale and the graph step. The guide on the right names it: which atoms vanished, which appeared.
2. **Balance it.** The answer is $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$. React again and the scale holds at 80.
3. **Puzzles.** The top bar opens five: Fix the claim, The missing molecule, Which picture is right?, Same total, wrong atoms, and at high school The odd oxygen. Each choice says why it is right or wrong.

> The puzzle that lands is Same total, wrong atoms: four atoms on each side and still not balanced. It catches the child who has learned to count atoms but not each kind.

The ideas, in plain words

An equation is a statement about atoms. If it is not balanced, it says some atoms appeared or disappeared, which never happens in a chemical reaction. The app plays that claim literally: the atoms with nowhere to go fade out and the scale drops, or atoms appear from nothing and it rises. In a real flask the extra molecules would simply be left over; the app says so at the high school level.

Balancing means choosing how many whole molecules of each substance there are. The coefficients change; the subscripts never do, because they are part of what the substance is. The smallest whole numbers are the usual answer, but any multiple is also balanced.

Common mistakes: matching the total number of atoms instead of each kind; changing a subscript; and balancing one element while unbalancing another.

Do it together

1. Open mytekdev.com/try/reactionlab?lesson=the-equation-that-lies&ref=fam-reactionlab-2 together. A short guide opens over the app with burning methane, not balanced yet. Press `React`.

   > **You'll know it worked when:** Some atoms fade out and the scale changes. The note on the right says which.

2. Balance it with the + and − buttons until every row in the Atoms card has an equals sign, then press `React` again.

   > **If you get stuck:** Methane needs two oxygen molecules and makes two water molecules.
   >
   > **You'll know it worked when:** The scale reads 80 before and after.

3. Press `Puzzles` in the top bar and try the three puzzles.

   > **If you get stuck:** Read the answer under a wrong choice: it says what went wrong.
   >
   > **You'll know it worked when:** Three ticks in the puzzle list.

4. Ask: what does an unbalanced equation claim happened to the atoms?

   > **You'll know it worked when:** Your child says atoms vanished or came from nowhere, and that real atoms never do.

Talk about it

Ask these while you work together. A child who has understood it can answer them without help:

- What did your unbalanced equation claim happened to the atoms?
- Which number did you change to balance it, and which one did you leave alone?
- Each side has four atoms. Why is that not enough?
- Why is the picture with three water molecules wrong?
- Is $4\ H_2 + 2\ O_2 \rightarrow 4\ H_2O$ balanced? Is it the smallest answer?

> The third question is the real test: the answer has to name each kind of atom.

For younger and older kids

Younger: For a younger child, do water instead of methane and only The missing molecule.

Older: For a teenager, switch the level to high school and solve The odd oxygen.

Keep going

- Switch to high school in the level menu and solve The odd oxygen.
- Write an unbalanced equation for photosynthesis and say exactly what it claims before balancing it.
- Find a reaction on the shelf that is already balanced as written, and say how you checked.

Bring it into other subjects

- Math: a balanced equation is a set of ratios. If 2 H_2 makes 2 H_2O, how much water does 10 H_2 make?
- English: write the unbalanced methane equation as a false news headline, then correct it.
- Computer science: describe the steps you use to check an equation is balanced, as a recipe a computer could follow.
- History: chemists in the 1700s weighed sealed vessels to prove that mass is conserved. Find out who and how.

For your records

Ready to copy into an hour log, a portfolio or a transcript.

LESSON	Reaction Lab: The Equation That Lies
SUBJECTS	Physical science
TIME	45 minutes
WHAT WE DID	Ran unbalanced chemical equations and described what they claimed, balanced burning methane with molecule models, and solved puzzles on balancing and conservation of mass.
SKILLS PRACTICED	Balancing chemical equations; Coefficients and subscripts; Conservation of mass

Activity sheet (optional)

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/reactionlab?lesson=the-equation-that-lies

Essential question: What is an unbalanced equation really saying about atoms?

Warm-up: A recipe says 2 eggs make 1 cake. Someone writes "2 eggs make 3 cakes." What is wrong?

_____

1. **Vocabulary.** Balanced equation, coefficient, subscript, claim, law of conservation of mass: write each in your own words.

2. **The claims table.** Unbalanced: $CH_4 + O_2 \rightarrow CO_2 + H_2O$. It claimed these atoms vanished _____ and these appeared _____. The scale went from ____ to ____. Balanced: ____ CH_4 + ____ O_2 → ____ CO_2 + ____ H_2O.

3. **Puzzles.** The missing molecule: _____ because _____. Which picture is right: _____ because _____. Same total, wrong atoms: _____ because _____.

1. Why can you not balance an equation by changing H_2O to H_2O_2?

2. $N_2 + H_2 \rightarrow NH_3$ has four atoms on each side. Is it balanced? Explain with each kind of atom.

Quick check

Name: _____

1. Which equation is balanced? (A) $H_2 + O_2 \rightarrow H_2O$ (B) $2\ H_2 + O_2 \rightarrow 2\ H_2O$ (C) $H_2 + O_2 \rightarrow H_2O_2$ written to make it balance

2. When you balance an equation, you may change: (A) the small numbers in a formula (B) the number of whole molecules (C) both

3. An unbalanced equation is run in a sealed flask on a scale. What would the scale show, and why can that not happen in a real reaction?

Answers

QUESTION	ANSWER	WHY
1	B	4 hydrogen and 2 oxygen atoms on each side. C changes the substance to hydrogen peroxide.
2	B	The small numbers are part of the substance.
3	The mass would change	The equation claims atoms were made or destroyed. Real atoms are not, so a real sealed flask keeps its mass. The change named with its reason is a full answer.

If your state or umbrella school asks, this lesson covers NGSS MS-PS1-5.

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The app this lesson uses is free and runs in the browser, with nothing to install and no account needed. It is at mytekdev.com.

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