SUPPORTING ADULT GUIDANCE

Keeping the balance

Equations, Inequalities and Simultaneous Relationships · Lesson 1. For any supporting adult — teacher, practitioner, parent or carer. **You do not need to be a mathematics specialist to support this lesson.**

What this lesson does

This opening lesson establishes solving a linear equation as **keeping the balance** — applying the same inverse operation to both sides until the unknown is isolated — and establishes **checking by substitution** as a non-negotiable final step. A balance-scale interactive makes 'do the same to both sides' literal before the written method is introduced as exactly the same moves recorded on paper.

Driving Question: *What value makes this true, and how do I undo my way to it?*

The mathematics, in plain terms

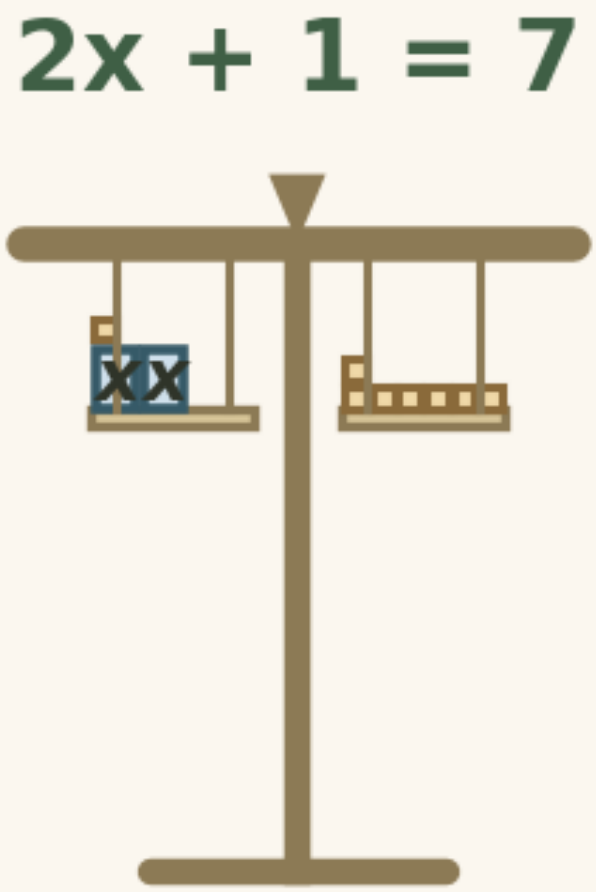
An equation states that two expressions are equal. Because they are equal, performing the same operation on both sides preserves that equality — so the equation stays true at every line. Solving means undoing, in reverse order, whatever was done to the unknown: clear an added or subtracted constant first (the inverse operation on both sides), then undo the multiplier by dividing. Substituting the result back into the original equation verifies it.

The worked method the learner sees

These are the two worked examples the learner meets on screen, with the lesson's exact method and notation. They are here for consistency, not because the mathematics is demanding — whether you teach mathematics or are meeting it afresh alongside the learner, working from the same steps and the same language keeps your support aligned with what is on the screen, and lets you point back to a line the learner has already seen. Skip them freely if the method is already familiar.

Example 1 — A two-step equation

Solve $2x + 1 = 7$, keeping both sides balanced.



1. Undo the + 1: subtract 1 from both sides.	$2x + 1 - 1 = 7 - 1$
2. Both sides stay equal.	$2x = 6$
3. Undo the × 2: divide both sides by 2.	$2x \div 2 = 6 \div 2$
4. One x now stands alone.	$x = 3$
5. Check by substituting back.	$2 \times 3 + 1 = 7$ ✓

$x = 3$ — subtract 1, then divide by 2; the check $2 \times 3 + 1 = 7$ confirms it.

Example 2 — A subtraction inside

Solve $3x - 4 = 8$. (First deal with the – 4, then the × 3.)



1. Undo the – 4: add 4 to both sides.	$3x - 4 + 4 = 8 + 4$
2. The equation stays balanced.	$3x = 12$
3. Undo the × 3: divide both sides by 3.	$3x \div 3 = 12 \div 3$
4. A single x is left.	$x = 4$
5. Check by substituting back.	$3 \times 4 - 4 = 8$ ✓

x = 4 — add 4 to both sides to get $3x$ = 12, then divide by 3; the check 3 × 4 – 4 = 8 confirms it.

Balance first, then the written method, then the check

Let the scales carry the idea before the symbols do: on the balance, removing the same blocks from both pans and splitting both pans equally makes 'the same to both sides' obvious. Then show that the written solution is those very moves recorded line by line. Insist on the substitution check every time — it is where 'I got an answer' becomes 'I know it is right'. Undo the added/subtracted term before the multiplier.

The shape of the lesson

Timings are invitations, not deadlines. A learner may need much longer on one phase and skim another — that is expected. Each Cornerstone is given an honest mathematical role here:

Cornerstone	Its role here	Invitational timing
Connection	Undo a function machine step by step to reveal the hidden number.	~8 min
Movement	Solve on a balance scale — the same operation on both sides until one x remains.	~13 min
Reflection	See the balancing written down as a chain of true equations, then check.	~10 min
Creativity	Build your own equation from a chosen answer — solving and building as inverses.	~8 min
Rest	A short pause to let 'both sides stay equal' settle.	~2 min
Nutrition	Name what the learning feeds: certainty you can check, and fairness as reasoning.	~3 min

Common misconceptions, and gentle repairs

These are the sticking points to expect. In every case, the aim is a question that returns the thinking to the learner — never to supply the answer.

Doing something to one side only (e.g. '$2x + 1 = 7$, so $x + 1 = 3.5$').
Return to the scales: 'If you take blocks off one pan only, does it still balance? What must you do to the other side?'

Undoing in the wrong order — dividing before clearing the added term.
Ask: 'What was done to x last? Undo that first.' Dividing $2x + 1$ by 2 splits the + 1 too, which they can see is wrong on the balance.

Confusing the inverse (subtracting to undo × 2, say).
Pair each operation with its partner out loud: add ↔ subtract, multiply ↔ divide. 'What undoes × 2?'

Producing an answer but never checking it.
Make substitution routine: 'Put your value back in — do both sides come out equal?' A failed check is useful information, not a verdict.

Protecting the support pathway

The lesson offers support in a deliberate order: **Socratic prompt** → **first try** → **hint** → **second try** → **worked solution**. The worked solution for each question stays locked until the learner has used the prompt, used the hint, and checked two answers. This is by design: the steps *are* the learning.

Please hold this line
Do not read the worked solution aloud, or talk a learner straight to the answer, while it is still locked. If they are stuck, use the Reconnection Routes, the prompt and the hint, or ask one of the repair questions above. Arriving at a correct line of reasoning — even slowly — is worth far more than being handed the result.

Reconnection Routes

If an earlier idea is blocking progress, the lesson's Reconnection Routes offer short recaps of exactly the prerequisites this lesson needs: inverse operations and directed (negative) numbers. A learner can choose one independently, or you can invite one without requiring it. Using a route is part of learning, not evidence of falling behind, and it always returns the learner to their place.

Supporting through questions: an example

Suppose a learner writes '$2x + 1 = 7$, so $x = 3.5$' (dividing the whole side by 2 too early), or reaches an answer and stops. The aim is a question that hands the reasoning back.

- "What was done to x last — the × 2 or the + 1? So which do we undo first?"

- “You subtracted 1 on the left — what has to happen on the right to keep it balanced?”
- “What is the opposite of × 2? Do that to both sides.”
- “Put your answer back into the original: do both sides come out equal?”

If they stall, that is the moment for a Reconnection Route or the lesson’s prompt and hint — not for the answer.

Questions you might have

Do learners have to draw the scales every time?

No — the scales are a way to *understand* why the method works. Once 'the same to both sides' is secure, the written lines are enough; the balance is there to return to if a step ever feels arbitrary.

What if the answer is not a whole number?

That is fine and expected — the stretch question gives $x = 1.5$. Fractions and decimals are perfectly good solutions; the check still works the same way.

Is 'move it to the other side and change the sign' allowed?

That shortcut is really 'do the same to both sides' in disguise, and it is where sign errors breed. Early on, keep the full both-sides step visible so the reasoning stays honest; the shortcut can come later.

How is this the start of the whole unit?

Everything ahead — brackets, fractions, unknowns on both sides, forming equations, and even simultaneous equations — rests on these two habits: keep the balance, and check by substituting back.

Keeping things regulated and calm

- Keep to one clear step at a time; there is no time pressure and no benefit to speed.
- Treat a wrong or unfinished answer as information for the next step, never as failure.
- Let the learner choose how to record — typed, written, drawn, spoken or annotated.
- If frustration rises, it is fine to pause and return later; the lesson holds their place.
- Avoid any language about age, school year or pace as a judgement of ability.

Recognising progress

Progress is described as Approaching Proficiency → Developing Proficiency → Proficiency → Refining Proficiency across understanding, application, communication and reflection. These describe where a learner is right now, not labels of what they are. Real understanding shown in part is still real understanding, even while other pieces are still settling.

Where they are	What it can look like

Approaching Proficiency	Beginning to engage; names some features and makes a start with support.
Developing Proficiency	Carries out the method with prompts; can explain part of the reasoning.
Proficiency	Works through independently and explains why each step is true.
Refining Proficiency	Applies the idea confidently to a new or unfamiliar case, and could teach it to someone else.

A note on evidence

Evidence can be captured in whatever form suits the learner — a photo of working, a short spoken explanation, an annotated Scratchpad image, or a written solution. There is no single required format. Incomplete work is information for the next connection, never a failure: it tells you exactly where to begin next time. The aim is a true record of the learner's thinking, not a tidy performance.

If a learner is stuck or distressed

Slow the pace and reduce the load: return to one concrete, familiar case and a single small question. Offer a Reconnection Route. Remind them they can pause and come back. A short, successful, low-stakes step rebuilds confidence more reliably than pushing through. Connection before curriculum — always.

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