

Solving two-step equations

CURRICULUM ALIGNMENT

ALG.EXP.4

articulate, represent and solve mathematical situations through the use of expressions and equations that include letter-symbols.

INTERACTIVES **Balance Scales** · challenge, display, explore

WHAT THIS LESSON TEACHES

An equation where the letter has two things done to it, for example multiplied and then added, as in $2x + 3 = 11$.

$$\rightarrow 2x + 3 = 11$$

$$\rightarrow 2x + 5 = 13$$

MODEL THIS ON THE BOARD

SOLVING ON THE SCALES

- 1 Take the loose cubes off both sides first
- 2 Then share out the bags by dividing

LESSON ARC

Open with $2x + 3 = 11$ on the balance-scales interactive — two bags plus three loose cubes against eleven. Pupils decide which move undoes first; hold the debate. Three worked puzzles pivot on 'peel the loose cubes off both pans before sharing the bags', including one take-away case. Pupils solve three in their copy showing two working lines, then the Student Activity Book page follows.

TEACHING MOVES

1. **Getting Started.** Put $2x + 3 = 11$ on the balance-scales interactive and take two or three hands-up answers only. Do NOT resolve which step comes first — that debate is the whole lesson. If a pupil says 'take the 3 off first', park their name and hold the idea for Watch and Notice.
2. **Watch and Notice.** Before solving puzzle one, ask the wrong-order question: 'what if we share the two bags with the 3 loose cubes still on the pan?' Let a pupil explain you can't read a clean bag value with extra cubes mixed in. On the third puzzle ($3x - 2 = 13$) make the add-to-both-sides move slow and loud — this is the step they forget.
3. **Try It Together.** Get the plan out loud before anyone touches the slider: 'which loose cubes come off first, then divide by what?' A pupil works $2x + 5 = 13$ at the board while the class agrees or corrects. Revoice a strong answer: 'so we peel the number off before we share out the bags.'
4. **Solve It in Your Copy.** Circulate glancing for two separate working lines, not just a boxed answer. Zero in on $3x - 1 = 14$ — watch for pupils dividing before they add the 1 back. This is practice, not marking; don't stop the whole class for individual slips.
5. **Class Challenge.** Keep the board turns brisk — pupil solves, class predicts where the beam levels, tick confirms, move on. Hold your nerve on the last one, $4x + 6 = 12$: wait for a pupil to realise $4x = 6$ gives $x = 1.5$ and that a bag really can hold half a cube.
6. **What Did We Notice?.** Point straight back to puzzle one: 'why couldn't we read a clean bag value with the loose cubes still on?' Revoice the rule: 'we undo the building in reverse — the last thing built is the first thing we take apart.' Display-only discussion; no writing.

COMMON MISCONCEPTIONS

⚠ Pupils divide first: for $2x + 3 = 11$ they write $x + 3 = 5.5$ or share the bags while the loose cubes are still on the pan.

Freeze the interactive with the 3 loose cubes still sitting on the pan. Ask: 'if we split these two bags now, what does one bag hold — and can you even tell?' Peel the 3 off both pans first, then share. The bag value only reads clean once the loose cubes are gone.

⚠ On a take-away equation like $3x - 2 = 13$, pupils subtract 2 (or ignore it) instead of adding 2 to both sides.

Show the missing cubes as a gap in the pan on the scales — the bag side is 2 short. To level it you have to put 2 back on both pans. Rebuild $3x - 2 = 13 \rightarrow 3x = 15 \rightarrow x = 5$ with the cubes going on, not coming off.

⚠ Pupils reject $4x + 6 = 12 \rightarrow x = 1.5$, saying 'you can't have half a cube' and re-check for an error that isn't there.

Confirm with the tick that the beam is level, so the answer is exact. Name it out loud: a bag can hold half a cube, and 1.5 is a perfectly good solution — not every answer is a whole number.

DIFFERENTIATION

EMERGING

- Keep the multiplier at 2 while the class moves to $4x$ and $5x$, and stay with add equations ($2x + 3 = 11$) before any take-away case.
- Have the pupil name the two lines aloud — 'take 3 off both sides... now share into 2 bags' — before writing, so the plan comes before the notation.

DEVELOPING

- After the copy page, swap $4x + 2 = 18$ for $4x - 2 = 18$ and ask what changes in the first line and why.
- Give a missing-number twist: $2x + ? = 15$ where $x = 4$ — what was added? Working the build backwards deepens the reverse-order idea.

PROFICIENT

- Pose $2x + 3 = 3x - 4$ with a letter on both sides and let them try it on the scales — no method shown; let them predict what happens when bags sit on both pans, forecasting the next lesson.
- Ask them to write a two-step equation of their own that lands on $x = 2.5$, then justify at the board why the answer isn't a whole number.

✂ **Cross-curricular:** Tie to STE — a see-saw balances when a lighter child sits further out; equal pans on the scales is the same 'keep it level' idea.

ANSWER KEY

Scaffold: visual check on the page

Q1: 4

Q2: 4

Q3: 5

Spot:

Undo the $** + 3$ first $**$: $2n = 11 - 3 = 8$, then $\div 2 \rightarrow **n = 4**$. (Check: $2 \times 4 + 3 = 11$. ✓)

EXTENSION SHEET · STRETCH ANSWERS

S1: $x = 11$

S2: $x = 10$

S3: $x = 8$

S4: $x = 5$

S5: $x = 7$