

Two-step equations: informal solving

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

A two-step equation multiplies the unknown and then adds or takes a number. Undo the add or take first on both sides, then divide to find the unknown.

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

$$\rightarrow 3x - 2 = 7$$

MODEL THIS ON THE BOARD

BEAM BALANCE FOR $2x + 5 = 13$

- ① The left pan holds $2x + 5$ and the right pan holds 13.
- ② Take 5 off both pans so the beam stays level: $2x = 8$.
- ③ Share the 8 equally across the two x-blocks: $x = 4$.

LESSON ARC

Put $2x + 3 = 11$ on the board and ask which of the two operations pupils would undo first — take hands, don't confirm. On the balance-scales interactive, work each beam live: take the added cubes off both pans, then split the x-blocks into equal shares. Pupils solve three in their copy, undoing addition before multiplication. The Class Challenge round runs four equations at the board, and the maths-talk tests why 'number off first' is cleaner.

TEACHING MOVES

1. **Getting Started.** Take two or three hands-up, not open call-outs, on 'what is happening to the x, and which would you undo first?' Do NOT confirm the order — that's the whole discovery. If a pupil says 'take the 3 away first', hold that thought silently for Watch and Notice.
2. **Watch and Notice.** Work each beam live on the balance-scales interactive; don't read the listed steps like a script. For $2x + 3 = 11$, lift the three unit cubes off both pans first, then ask 'how many in one x-block if two together match eight?' Slow right down on $4x + 1 = 21$ — the small added number is the one pupils forget to remove.
3. **Try It Together.** Take 5 off both pans ($2x = 8$) before anyone touches the slider — the slider checks the answer, it isn't how we find it. Have pupils say their x aloud, then slide only to confirm the beam settles level. Listen for anyone splitting before removing the number; revoice: 'so we tidy the pan first, then share the x-blocks.'
4. **Unwind It in Your Copy.** Walk the room glancing for the two lines of working, not just the final answer. Catch anyone dividing before subtracting on $3x - 2 = 7$ or forgetting the 1 in $4x + 1 = 21$. Remind pupils to check by putting their answer back into the first line.
5. **Class Challenge.** Brisk practice — pupils take turns at the board, tidy the pan, work out x, then slide and press Check before the class moves on. If a slide lands wrong, ask 'did we tidy the pan before splitting?' rather than giving the answer. Don't re-explain each one; keep the four equations moving.

6. What Did We Notice?. Run this on the board, not the integer slider — the split-first route lands on 1.5, which the whole-number slider can't show. Work both routes aloud on $2x + 3 = 11$ and revoice: 'taking the number off first keeps the x-blocks whole, which is why it's the easier order.'

COMMON MISCONCEPTIONS

⚠ Pupils divide before subtracting: for $2x + 3 = 11$ they write $x = 5.5$ ($11 \div 2$), forgetting the +3 or splitting it by mistake.

On the balance-scales interactive, split the pan first and show that halving 3 gives 1.5 — messy. Then rebuild it the tidy way: lift the 3 cubes off both pans first, THEN split the x-blocks. Let them see which route keeps whole blocks.

⚠ On subtraction cases like $3x - 2 = 7$, pupils take 2 off instead of adding 2, treating every equation as 'take the number away'.

On the beam, show the -2 as cubes owed on the x-side. To clear it you add 2 to both pans ($3x = 9$), then split. Ask 'is the number being added on or taken off here?' before they move.

DIFFERENTIATION

EMERGING

- Stay on the $2x + 3 = 11$ type only — small coefficients, addition case — while the class moves to subtraction. Pupils mirror on the beam with you before writing anything.
- Give a two-line frame in the copy: line one 'take the number off both sides', line two 'split the x-blocks', so pupils fill values rather than invent the layout.

DEVELOPING

- After the copy work, hand a subtraction case like $5x - 3 = 12$ and ask which move comes first and why.
- Pose a missing-number variant: $3x + ? = 17$ where $x = 4$ — pupils work back to find the added number.

PROFICIENT

- Pull them ahead into the Student Activity Book page while the class finishes the Class Challenge, or pose: 'make up a two-step equation whose answer is exactly $x = 7$, then a second one with the same answer that looks completely different.' Ask them to explain to you why both must give 7.

✚ **Cross-curricular:** Tie to science — pupils write a 'cost' rule like $2x + 3$ for a fixed charge plus a per-item price, then solve back to find how many items a total of €11 buys.

ANSWER KEY

Scaffold: visual check on the page

Q1: 9

Q2: 6

Q3: 5

a) **Always** : Addition is undone before division so the beam stays balanced.

b) **Never** : The added or taken number must be undone first.

c) **Always** : That leaves a simple one-step equation for x.

d) **Never** : Halving 11 gives 5.5, but the 3 is not shared: take away 3 first to get $2x = 8$, so $x = 4$.

EXTENSION SHEET · STRETCH ANSWERS

S1: $x = 5$

S2: $x = 9$