Lesson 112 ALGEBRA

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.

→ 2x + 3 = 11

→ 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 → 3x = 15 → x = 5 with the cubes going on, not coming off.

⚠ Pupils reject 4x + 6 = 12 → 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

a) Always — This undoes the operations in the correct order.

b) Sometimes — Some like 4x + 6 = 12 give a fraction.

c) Always — It isolates the term with the variable.

d) Never — The order of inverse operations must be followed.

EXTENSION SHEET · STRETCH ANSWERS

S1: $x = 11$

S2: $x = 10$

S3: $x = 8$

S4: $x = 5$

S5: $x = 7$