

Equality and the balance

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

The = sign says the value on the left is the same as the value on the right. It does not mean work out the answer and write it here.

→ $x + 3 = 7$ means whatever $x + 3$ comes to must equal 7.

→ In $x + x = 8$ the two same x values share 8 so each is 4.

MODEL THIS ON THE BOARD

LEVELLING $x + 4 = 9$ ON THE BEAM

- 1 Write the equation $x + 4 = 9$ on the top line.
- 2 The right pan holds 9 so slide x until the left pan also holds 9.
- 3 x becomes 5 because $5 + 4$ makes 9.
- 4 Both pans now match and the beam sits level.

LESSON ARC

Open by picturing a balance beam with $x + 3$ on the left pan and 7 on the right; give quiet think-time before any hands. Walk four settled beams on the balance-scales interactive, pointing at the equation under each until the class can say both pans weigh the same. Try three more together with predict-then-slide. Pupils write three-line find- x working in their copybooks, then run the Class Challenge bank at the board checking each answer as they go.

TEACHING MOVES

1. **Getting Started.** Give five seconds of quiet think-time on the tipping beam before any hands. Take two or three hands-up guesses for what x must be — do not confirm yet. Say we'll test each idea on the beam in a moment.
2. **Watch and Notice.** Take the four beams in screen order. On $x + 3 = 7$ hold out for 'both pans come to 7, so the beam is level.' On $2x = 10$ ask how much one block is worth. On $x + x = 8$ revoice: eight shared between two copies, not eight itself. On $x - 4 = 9$ ask why x can't just be 9 before naming it. Do not move on until the class can say the two pans weigh the same.
3. **Try It Together.** Pupils take turns at the board; class predicts before anyone slides x , then watches the beam settle. On $x + 4 = 9$ have the pupil say both pan totals aloud. On $x + 6 = 15$ ask how far off the left pan is as they slide. Slow down on $3x = 12$: 'three copies weigh twelve, so one copy weighs four.'
4. **Work It in Your Copy.** Write the three-line model on the board first — equation, how the beam levelled in words, value of x — then set the three problems. Walk the room glancing for missing middle lines; nudge those pupils to name pan totals matching or the total shared between copies. Pupils who need the picture can sketch two pans beside each problem.

5. **Class Challenge.** Keep board turns brisk — slide, press Check, class confirms, move on. Narrate each tick as 'yes, the beam is level.' On $x - 4 = 9$ ask for a prediction before sliding; on $3x = 12$ listen for sharing language, three copies share twelve.
6. **What Did We Notice?.** Listen for pupils naming = as balance — same value on both sides. Head off 'write the answer here': on the beam there is no next, only same on both sides. Revoice a strong answer: 'the equals sign is a see-saw sitting level, not an arrow pointing to the answer.'

COMMON MISCONCEPTIONS

⚠ Pupils treat = as 'work this out and write the answer after the sign' — so for $x + 3 = 7$ they say 'the answer is 10' or leave x blank and write 10 after the equals.

Freeze on the beam. Point at both pans: 'there is no next — only left and right. What must the left pan come to so it matches the right?' Rebuild until they say both sides are 7.

⚠ On $x + x = 8$ or $2x = 10$, pupils set x equal to the whole right-hand total — 'x is 8' or 'x is 10' — instead of sharing between the copies.

Point at the two identical blocks on the left pan. Ask: 'how many copies share this total?' Revoice: 'eight shared between two copies means one copy is four.'

⚠ On $x - 4 = 9$, pupils set $x = 9$ because they see 9 on the right and ignore the block taken away.

Ask why the beam tips if x is only 9. Show the left pan as x with 4 removed: to still weigh 9 after taking 4 away, x itself must be bigger than 9 — slide until it settles at 13.

DIFFERENTIATION

EMERGING

- Stay with one-addend forms like $x + 3 = 7$ and $x + 4 = 9$; keep the balance interactive on screen so they can slide rather than hold the picture in their head.
- Accept a sketched two-pan drawing beside the three copybook lines as the middle 'how it levelled' line — pan totals matching is enough.

DEVELOPING

- After the copybook set, ask them to write one new equation of their own that levels when $x = 5$, then check it on the beam.
- On a sharing case, cover the answer and ask: if four copies weighed 20, what would one copy be — before sliding.

PROFICIENT

- During Class Challenge, after they level a beam correctly, ask them to change one number on either pan and say what x must become to keep it level — still on the same interactive turn.
- In the copybook, add a fourth line: 'why x cannot be ____' naming a near-miss value and the pan totals that would not match.

✂ **Cross-curricular:** Link to science — a pan balance in a weighing investigation shows the same idea: both sides equal when the beam sits level.

ANSWER KEY

a) 4

b) 6

c) 4

Q1: 4

Q2: 5

Q3: 4

a) Always : That is exactly what the balance beam shows when it sits level.

b) Never : The equals sign means both sides match, so x must be 4 to make the left side 7.

c) Always : A level beam is the picture of equality.

d) Never : Three copies of x share 12 so each x is 4.

EXTENSION SHEET · STRETCH ANSWERS

S1: $x = 23$

S2: $x = 19$

S3: $x = 55$

S4: $x = 22$

S5: $x = 11$