Lesson 25 NUMBER

Square numbers and number patterns

CURRICULUM ALIGNMENT

ALG.PRR.4a identify, explain and apply generalisations, including properties of operations, mathematical models and patterns.

ALG.PRR.4b represent mathematical structures in multiple ways, including verbal expressions, diagrams and symbolic representations.

INTERACTIVES Area Model · challenge, display, explore

WHAT THIS LESSON TEACHES

A square number is made when a whole number is multiplied by itself, forming a perfect square array of dots.

→ 5 × 5 = 25, so 25 is a square number.

→ 7 squared means 7 × 7 = 49.

MODEL THIS ON THE BOARD

FINDING A SQUARE NUMBER

1. Count the side length of the square array of dots.
2. Multiply that side length by itself to get the total dots.
3. Write it as n squared = n × n = total.

LESSON ARC

Open with a 5×5 dot array on the IWB and let pupils connect the side count to the total before naming it a square number. Model 4^2, 5^2 and 6^2 on the area model, pointing to the new row and column so the odd-number gap becomes visible. Pupils build 7^2, 8^2, 9^2 together at the board, then write squares two ways in copybook. Class Challenge extends to 10^2–13^2; wrap by reasoning why the gap is always odd.

TEACHING MOVES

1. **Getting Started.** Display the 5×5 dot array as pupils settle and give five seconds of silent think-time before any hands. Take three answers to 'how many along one side?' and 'how many altogether?' before revealing 5 × 5 = 25 — let them make the connection, don't tell it.
2. **Watch and Notice.** The 6^2 build is the pay-off, not 4^2. On the area model physically point to the new bottom row of six, the new side column of five, and the shared corner so pupils see why the gap is 6 + 5 = 11. Prediction moments are thumbs-up-when-ready, then two hands to say it aloud.
3. **Try It Together.** One pupil drives the board setting both factors equal; the rest predict the total aloud from the side length before the build reveals it. After 8^2 and 9^2, ask the class for each gap (15, then 17) and confirm they're the next odd numbers after 13.
4. **Write the Squares in Your Copy.** Walk the room glancing at layout and the gaps pupils write beneath their row of ten squares — this is practice, not marking. Watch for pupils who write the squares correctly but leave the gap row blank; that's the bit that carries the pattern.
5. **Class Challenge.** Keep the board builds brisk — one pupil per square (10^2 through 13^2), class predicts and confirms, move on. Don't re-explain each build. If a pupil gives a clean gap explanation, revoice it for the whole class rather than stopping to reteach.

6. **What Did We Notice?.** Ask why growing a square by one on each side always adds an odd number. Listen for 'old side plus new side, minus the shared corner'. Revoice a strong answer and head off the guess that the gap doubles — it rises by two each time, it does not double.

COMMON MISCONCEPTIONS

⚠ Pupils say 6^2 means 6 × 2 = 12 — they read the small raised 2 as 'times two' rather than 'multiplied by itself'.

Build 6 × 2 and 6 × 6 side by side on the area model. One is a thin strip, the other a full square. 'The little 2 tells us how many sixes — no, it tells us it's a square, both sides the same.' Say '6 squared is 6 × 6' in unison.

⚠ When told the gap grows, pupils predict it doubles — 'the gap was 9, so the next one is 18'.

Line up the gaps on the board — 9, then 11, then 13. Ask 'how much bigger is each gap than the one before?' Land that it goes up by two each time, always the next odd number, never doubling.

⚠ Pupils count the added row and column when a square grows but double-count the corner dot, giving an even gap.

Point to the shared corner on the area model and cover it with a finger. 'The old side, then the new side — but this corner belongs to both, so we don't count it twice.' Recount to show the gap lands odd.

DIFFERENTIATION

EMERGING	DEVELOPING	PROFICIENT
• Keep these pupils on 2^2, 3^2, 4^2 in copybook while the class moves higher — same area model, smaller squares to count. • Give the printable square-numbers reference card (first ten squares written both ways) so they check their own layout against a model rather than inventing it.	• After the copybook row, ask which square numbers are odd and which are even, and whether they can spot the pattern in that. • Pose $12^2 = 144$ and ask them to predict 13^2 using only the gap rule (add the next odd number) before checking with a build.	• Take the optional stretch further: after 9 + 16 = 25 ($3^2 + 4^2 = 5^2$), ask them to hunt for a second pair of squares that add to a square, and to explain in copybook why most pairs won't work.

↗ **Cross-curricular:** Tie to Geography — pupils work out how many 1 m^2 paving slabs tile a square yard that's 4 m along each side, and check it's a square number.

ANSWER KEY

c) 36

Q1: 49

Q2: 64

Q3: 25

Q4: 225

Q5: 484

Q6: 169

a) Always — By definition, square numbers form exact n-by-n grids.

b) Always — Because 6 squared is 36, following 5 squared.

c) Sometimes — They are even only when the side length is even.

d) Never — Gaps between consecutive squares are always odd numbers.

EXTENSION SHEET · STRETCH ANSWERS

S1: 144

S2: 100

S3: 49