Lesson 105 ALGEBRA

Rules for patterns using words and tables

CURRICULUM ALIGNMENT

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

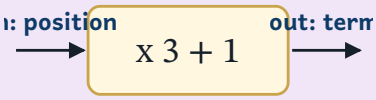
ALG.PRR.4b represent mathematical structures in multiple ways, including verbal expressions, diagrams and symbolic representations.

INTERACTIVES Function Machine · challenge, display, explore

WHAT THIS LESSON TEACHES

A **rule** links a term's **position** to its value. A table of position and value helps you find it.

→ Position × 4 − 1 gives 3, 7, 11, 15… (term n = 4n − 1).



MODEL THIS ON THE BOARD

FIND THE RULE FOR 4, 7, 10, 13, …

1. It goes up **3** each time, so the rule uses 3 × position.
2. Position 1 gives 4, so the rule is **3 × position + 1**.
3. Check position 4: 3 × 4 + 1 = 13. ✓

LESSON ARC

Open with a growing tile pattern (3, 5, 7) on the IWB and pose 'how many at term 10 — without drawing all ten?' as held tension. Feed term-numbers through the function-machine interactive and tabulate the values on a two-row board table, pivoting on 'the jump between values is what you multiply by'. Pupils build the table and write the rule sentence in their copies. The Class Challenge is a hidden-rule matchstick-square investigation, leaping to the 50th term.

TEACHING MOVES

1. **Getting Started.** Take three hands-up answers only — some pupils will keep counting up (9, 11, 13…) and that's fine. Hold the 'without drawing all ten' part open; don't resolve it. Let that tension carry the lesson.
2. **Watch and Notice.** Run all three examples one at a time, building the two-row table beside the machine. Before revealing each rule, ask 'what jumps from one value to the next?' and take two hands-up answers. Make the bridge explicit on the board: the jump is the multiply, the small add/subtract lands you on the first value. Example 3's 'take away one' catches pupils out — have them name the step of 4 before you reveal the −1.
3. **Try It Together.** Set the machine to ×2 then +1 in explore mode (rule visible). Call a term-number, have the whole class predict the value before one pupil sends it through. Rotate four pupils through terms 4, 5, 6, then jump to term 10. Watch for pupils who add 1 first then multiply — revoice 'multiply by two FIRST, then add the one.'
4. **Build the Table in Your Copy.** Pupils draw their own two-row table, labels and all, and fill terms 1–5. Walk the room glancing that terms 4 and 5 read 9 and 11, and that the rule is written as a full sentence — this is practice, not marking, so keep moving.

5. **Class Challenge.** Keep it brisk — this is consolidation, not re-teaching. Run the warm-up (×3) and matchstick squares (×3 then +1) as core: send 1, 2, 3 through, tabulate (1→4, 2→7, 3→10), name the visible step of 3 before the ×3, then link the +1 to the first square needing four matchsticks. For term 50, push the rule (50 × 3 + 1 = 151), not counting up.
6. **What Did We Notice?.** Ask which view — picture or table — made the rule easier to spot, and why. Listen for pupils naming the table as where the constant step jumps out, and revoice: 'the table lines the values up so we can see the jump, and the jump is what we multiply by.'

COMMON MISCONCEPTIONS

⚠ Pupils apply the rule out of order — for term 4 they do 4 + 1 then × 2, getting 10 instead of 9.

Send the term back through the machine in explore mode so the class sees ×2 happen first, then +1. Revoice 'multiply FIRST, then add' and have them re-run term 4 on the board to land on 9.

⚠ Pupils think they must list every term to reach the 50th, so they start writing out the whole pattern.

Stop them and point to the rule sentence already on the board. Put 50 straight into it: 50 × 3 + 1 = 151. Make the point that the rule beats continuing the pattern because it works for any term at all.

⚠ Pupils name only the step ("it goes up by 3") and stop, never finding what to add or subtract to land on the first value.

On the matchstick table, ask 'term 1 times 3 gives 3, but the machine gave 4 — what fixes that?' Let them spot the +1 themselves before you confirm the full rule.

DIFFERENTIATION

EMERGING

- Keep these pupils on a multiply-only rule (×3, no add) during the copybook table so the step and the rule match exactly — no adjustment to juggle yet.
- Pre-draw the two-row table with the term-number row already filled 1–5 so they only place the values, not build the structure.

DEVELOPING

- After the copy table, ask them to find term 20 using the rule and check it against the step pattern — do both routes agree?
- Give a missing-input puzzle: 'the machine output 21 with the ×2 +1 rule — which term-number went in?'

PROFICIENT

- During the Class Challenge, narrate the stretch sub-challenge (×5 −2) and ask them to leap to term 50 and explain in a sentence why the rule is faster than counting up.
- Pose a backwards investigation: give them the rule ×4 +1 and ask them to invent the matchstick picture that grows that way.

Cross-curricular: Tie to STE — pupils tabulate how a row of desks seats more pupils as you add desks, then write the rule linking desks to seats.

ANSWER KEY

W1: $\times 9$

W2: 8

Q1: $+13$

Q2: 15

Q3: $\times 6 + 4$

Q4: 68

EXTENSION SHEET · STRETCH ANSWERS

S1: 129

S2: $\times 3 + 6$

S3: 63

S4: $\times 3 + 8$

S5: $+11$