

Describing a rule in words

CURRICULUM ALIGNMENT

ALG.PRR.4b

represent mathematical structures in multiple ways, including verbal expressions, diagrams and symbolic representations.

ALG.PRR.4a

identify, explain and apply generalisations, including properties of operations, mathematical models and patterns.

INTERACTIVES Function Machine · challenge, display, explore

WHAT THIS LESSON TEACHES

A rule in words is a plain sentence that tells a friend exactly how to get from one term to the next in a number pattern so they can carry it on without seeing any working.

→ For 4, 7, 10, 13 the rule is 'start at 4, then add 3 each time'.

→ For 1, 3, 7, 15 each term is 'double, then add 1'.

MODEL THIS ON THE BOARD

FINDING THE RULE FOR A GAME SCORE PATTERN

- ① Look at the scores 4, 7, 10, 13 from a board-game round.
- ② See what changes each time: 4 to 7 is up by 3, 7 to 10 is up by 3, 10 to 13 is up by 3.
- ③ Say the rule in plain words: start at 4, then add 3 each time.
- ④ Check it works: add 3 to 10 and you get 13, which matches, so the wording is correct.

LESSON ARC

Put 4, 7, 10, 13 up and take three hands-up rules in the pupils' own words on the board. Run four function machines — add 3, take 5, double, then the make-or-break double-then-add-1 — feeding outputs back as inputs so pupils see the order matters. Pupils write all four sequences and their rules in their copybook. Try It Together and the Class Challenge machines drill saying a rule another person could actually follow.

TEACHING MOVES

1. **Getting Started.** Take three hands-up rules, not call-outs, and write each one on the board exactly as the pupil says it — 'plus three', 'goes up by three', 'add three each time'. Leave all three up so the class can weigh the wording later.
2. **Watch and Notice.** Run the first three machines briskly and bank your time for double-then-add-1. On that one, feed each output back in on the board: 1 doubles to 2, add 1 makes 3; send 3 back, doubles to 6, add 1 makes 7. Then do add-1-first-then-double and show the number changes — that's how pupils see order is part of the rule, not your say-so.
3. **Try It Together.** Send a number through the add-3 machine, then ask for the rule in words before the next one goes through. Hold the wording to something usable — 'add 3' passes, 'it gets bigger' doesn't (bigger by how much?). Turn-and-name a different pupil each time and revoice the strongest answer word for word.
4. **Write the Rules in Your Copy.** Walk the room checking each rule names both the action and the amount, and the verb is underlined. The 1, 3, 7, 15 line is the one to glance at — one verb won't cover a two-step rule. This is copybook practice, not marking.

5. **Class Challenge.** Brisk practice: rule in words first, then predict, then Check. When a weak wording survives a pair, ask the class for an input it would get wrong — that's the test that catches it. On the last two, hold pupils to naming both jobs and the order ('multiply first, then add'), and frame the final machine openly as a stretch.
6. **What Did We Notice?.** Listen for the verb leading every rule — add, take, double, multiply — and revoice that the verb is the engine: tell a friend what to DO first, then by how much. Display-only discussion.

COMMON MISCONCEPTIONS

⚠ Pupils describe the doubling pattern 1, 2, 4, 8 as 'add 1, then add 2, then add 4' — they read each gap as a new step instead of one repeated move.

On the function machine, send each number through on its own and show every one doubles independently. Revoice as 'each one doubles' — a single move that works on any input, not a growing list of additions.

⚠ For 1, 3, 7, 15 pupils write a one-verb rule like 'double' and stop, missing the second job. Send 1 through: doubling gives 2, but the pattern shows 3. Ask 'what got us from 2 to 3?' Lead them to 'double, then add 1', then test it on $3 \rightarrow 7$ so they see both jobs are needed.

⚠ Pupils treat order as cosmetic — they think 'double then add 1' and 'add 1 then double' describe the same rule.

Run both orders on the board with the same input: $1 \rightarrow \text{double} \rightarrow 2 \rightarrow \text{add } 1 \rightarrow 3$, versus $1 \rightarrow \text{add } 1 \rightarrow 2 \rightarrow \text{double} \rightarrow 4$. Different numbers, so the order is part of the rule.

DIFFERENTIATION

EMERGING

- Stay on the single-step machines (add 3, take 5) in the copybook while the class moves to doubling; hold these pupils to naming the verb and the amount.
- Give a sentence frame on the board — 'start at ____, then ____ each time' — so pupils fill the rule rather than build the wording from nothing.

DEVELOPING

- After the copybook page, hand them 2, 5, 11, 23 and ask them to find the two-step rule and write it in under eight words.
- Ask them to write a rule that would get the next term wrong on purpose, then name the input that exposes it — the same test the class uses on weak wordings.

PROFICIENT

- During the Class Challenge, narrate a harder hidden-rule machine for them — 'multiply by 3, then subtract 2' — and ask them to crack the rule and state it in exactly six words before the Check.
- Pull them ahead into the Student Activity Book table-of-values work: send several inputs through one machine and record each input beside its output, noticing what stays the same.

✂ **Cross-curricular:** Tie to English — a good rule is like clear instructions; have pupils swap written rules and see if a classmate can carry the pattern on from the words alone.

ANSWER KEY

a) add 5 each time

b) take 5 each time

c) double then add 1

Q1: start at 21, add 3 each time

Q2: start at 48, take 5 each time

Q3: double each time

Q4: double then add 1 each time

Q5: double then add 1 each time

Q6: multiply by 3 each time

a) **Always** : Adding 3 each time matches every step of that pattern.

b) **Always** : That is exactly what a clear rule in words is for.

c) **Never** : Rules can also double, subtract or do two steps such as double then add 1.

d) **Always** : Each term is made by doubling the one before and then adding 1.

EXTENSION SHEET · STRETCH ANSWERS

S1: $\times 3 + 2$

S2: $\times 3 + 8$

S3: $\times 3 + 6$

S4: $\times 5 + 4$

S5: -6