

## Continuing a pattern: what comes next?

### 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

Each number in a pattern or sequence is called a term. Spot the rule that links one term to the next, then use the same rule to find what comes next.

- In 2, 5, 8, 11 the third term is 8.
- 2, 5, 8, 11 follows the rule 'add 3 each time'.
- 1, 3, 7, 15 follows 'double then add 1'.

### MODEL THIS ON THE BOARD

#### CONTINUE THE GAME SCORES

- ① Look at the sequence 1, 3, 7, 15.
- ② Check the rule: double then add 1 gives  $1 \times 2 + 1 = 3$ ,  $3 \times 2 + 1 = 7$ ,  $7 \times 2 + 1 = 15$ .
- ③ Apply the same rule to 15:  $15 \times 2 + 1 = 31$ .
- ④ Apply it once more:  $31 \times 2 + 1 = 63$ .
- ⑤ So the next two terms are 31 and 63.

### LESSON ARC

Open with 2, 5, 8, 11 on the IWB and five seconds of quiet think-time before taking two or three hands-up guesses — leave the rule unnamed. Walk four function machines: add 3, double, subtract 5, then double-and-add-1, pointing at each jump. Pupils probe a hidden-rule machine together predicting outputs aloud, write three sequences and their rules in the copybook, then say both steps of a two-step machine before the Class Challenge bank. Wrap by testing whether a rule must hold for every step, not just the last jump.

### TEACHING MOVES

1. **Getting Started.** Display 2, 5, 8, 11 and hold five seconds of silent think-time. Take two or three hands-up answers only. Listen for whether they spotted the jump of 3 or are guessing — do not name the rule yet; the machines own that reveal.
2. **Watch and Notice.** Start with the friendliest machine (add 3). Point to each jump as you say plus three, plus three, then ask what the machine is doing. On the doubling machine, pause before revealing 16 and draw out that the jumps themselves are growing. Walk the two-step slowly: take 7, double to 14, add 1 to make 15 — point at both operations.
3. **Try It Together.** Pupils take turns choosing an input at the board. Before each reveal, the class predicts the output and says why. Revoice a strong answer: 'so the rule adds three every time, no matter what number we start with.' Mix single-digit and two-digit inputs so the rule shows clearly.

4. **Write the Rule in Your Copy.** Pupils write the first three terms, continue two more, and write the rule in words underneath. Walk the room glancing at whether the written rule actually matches the numbers they continued — whole-class copybook practice, not marking.
5. **Try a Two-Step Machine Together.** Stay on double-then-add-1. Choose an input, then ask the class for step one ('double it') and step two ('add 1') before revealing. Revoice: 'double the 4 makes 8, add 1 makes 9.' Run two or three inputs so every pupil has said both steps aloud.
6. **Class Challenge.** Brisk board turns — class confirms each answer before moving on. Build from single-step rules to the two-step at the end. On a miss, use the machine's counter-example input as the teaching point rather than just saying wrong. For the final machine, draw out both operations the same way you practised.
7. **What Did We Notice?.** Ask who is right: the pupil who checks only the last jump, or the one who tests every step. If someone offers a wrong rule that fits two terms, try it on a third so the class watches it break. Revoice: 'so we test the rule on every step, not just the last one.'

### COMMON MISCONCEPTIONS

⚠ Pupils copy only the last jump — they see 8 then 11, say 'add 3', and never check the rule against the earlier terms or a fresh input.

Send a new input through the hidden-rule machine and ask them to predict before the reveal. If their jump fails on the new number, revoice: 'one matching jump is not enough — the rule has to hold every time.'

⚠ On a two-step machine, pupils name only one operation: they say 'it doubles' for 1, 3, 7, 15 and stop, or they invent a single add that fits two terms by luck.

Walk one input slowly on the IWB: double 7 is 14, then add 1 is 15. Point at both moves. Then try their single-step guess on the next term so the class sees it break.

⚠ Pupils treat 'what comes next' as a free guess and call out a plausible-looking number without stating any rule at all.

Block the call-out and ask 'what did the machine do to the number before?' Refuse the next term until the action is named in words — add 3, double, take away 5.

### DIFFERENTIATION

#### EMERGING

- Stay on the add-3 and take-away-5 machines only; leave doubling and two-step for teacher-supported turns at the board.
- In the copybook, pre-write the first three terms so the pupil only continues two more and finishes the sentence 'the rule is add \_\_\_\_ each time'.

#### DEVELOPING

- After a correct single-step rule, swap the starting number and ask whether the same rule still holds — and how they know.
- On the subtract-5 sequence, ask what the tenth term would be without listing every step, and have them justify the shortcut.

#### PROFICIENT

- During Class Challenge, give a fresh two-step oral prompt the machine has not shown — 'multiply by 3 then take 1' — and have them predict three outputs before any reveal.
- Ask them to write a rule in words that another pupil could follow cold, then test it on a number the first pupil never used.

✦ **Cross-curricular:** Tie to music — clap 2, then 4, then 8, and freeze before the next burst so the class predicts the double.

### ANSWER KEY

a) 14, 17

b) 16, 32

c) 79, 159

Q1: 34, 39

Q2: 144, 288

Q3: 25, 30

Q4: 111, 223

Q5: 47, 95

**Q6:** 63, 127

**a)** Always : Each term is exactly 3 more than the one before it.

**b)** Always : Doubling each time gives 1, 2, 4, 8, 16.

**c)** Never : It goes on to 48, 96 and then 192, which is over 100.

**d)** Sometimes : True for 3, 7, 11, 15; false for 2, 4, 8, 16, which doubles.

#### EXTENSION SHEET · STRETCH ANSWERS

**S1:** 14

**S2:** 2

**S3:** -6

**S4:** 45

**S5:** 43