Building Sequences from the Real World

Students turn stories, tables, and picture patterns into arithmetic or geometric sequences, write the rule with the right number of steps, interpret the numbers in context, and answer far-term and which-term questions.

TIME	45 minutes (one student with a parent or tutor, or a small group)
WHO	Math 1 (algebra readiness), about age 12. Follows Unit 9, Lesson 4. Closes Unit 9.
MATERIALS	Student worksheet (PDF), the Deep Dive 5 interactive page for this lesson, pencil, calculator, a few paper cups to stack if you have them
PRIOR KNOWLEDGE	Arithmetic and geometric sequences and both kinds of rule (Lessons 2 to 4). Linear or exponential from a table (Unit 7, Lesson 5). Simple and compound interest (Unit 8).
STANDARDS	NC.M1.F-BF.1a, NC.M1.F-BF.2, NC.M1.F-LE.1.
KEEP OUT	Data that is only roughly linear or exponential (Unit 10).

Learning goals

1. Decide whether a situation is arithmetic or geometric from equal differences or equal ratios.
2. Write the explicit rule, saying what n counts and whether the counting starts at 0 or at 1.
3. Interpret the numbers in the rule in context, including the zeroth term.
4. Answer a far-term question and a which-term question, and eliminate wrong rules with reasons.

Vocabulary: say both, every time

The rule for the whole lesson: whenever the adult or the student says a math word, they follow it with the plain-English version. Proper term first, plain English second, until the student does it without being asked.

TERM	LOOKS LIKE	PLAIN ENGLISH
Arithmetic, geometric	adds; multiplies	Equal differences; equal ratios.
Common difference, ratio	d; r	The step.
Model	a rule for a situation	Say what n counts.
Zeroth term	one step before the first	A plain pizza.

> THE ONE SENTENCE TO SAY OUT LOUD
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> Adding gives arithmetic, multiplying gives geometric. Ask what n counts and where the counting starts.

Lesson timeline (45 minutes)

0:00 to 0:05	Warm-up: stack cups. Measure one cup and the lip. Predict the height of 5 cups, then of 20. Hold the prediction.
0:05 to 0:20	Mini-lesson: three moves, four situations. Type, rule, answer. Pizza (and the meaning of 10.50), cups (check the warm-up), bacteria (starts at 0, so n steps). Tie in the Unit 8 balances. Run two of the pattern-to-rule builders.
0:20 to 0:28	The orchard by elimination. Work out 6 a year, then use the multiple choice to say what rules out each wrong rule. Discuss n against n – 1.
0:28 to 0:40	Practice. The story practice or Worksheet Parts B to E. Same buttons: Hint, Show next step, Reveal answer, Hide help.
0:40 to 0:45	Exit ticket. Worksheet Part F. Success looks like 15 + 25n and 384.

Misconceptions to listen for

- **Always n − 1.** Only when the counting starts at 1.
- **The start goes with n.** In 6n + 4 the 6 is the step and the 4 is the start.
- **A percent each time adds.** It multiplies: geometric.
- **The zeroth term is meaningless.** Sometimes it is a real thing, like a plain pizza.
- **Solving 2 to the n = 1000 with algebra.** Build a table.

Support and stretch

Support

For each story, make a three-row table first: n, the value, and the step between. Circle where the counting starts. Use real cups.

Stretch

Ask for both a rule numbered from 0 and a rule numbered from 1 for the same orchard. Ask how many cups make a stack taller than the student.

Where this goes next

Unit 10: linear and exponential regression. Real data is messier, with differences or ratios only close to equal, so you find the line or curve that fits best. The opening question is the same: does it look like it adds, or does it look like it multiplies?

> THE HABIT TO BUILD
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> Type, rule, answer. Say what n counts and where it starts.