Slope: The Rate of Change Gets Its Name

Students name the rate of change from Unit 2: slope, rise over run. They find it three ways (graph, table, two points) and read the sign and size, including the flat and vertical cases.

TIME	40 minutes (one student with a parent or tutor, or a small group)
WHO	Math 1 (algebra readiness), about age 12. Follows Unit 2, Lesson 6 (average rate of change).
MATERIALS	Student worksheet (PDF), the Deep Dive 5 interactive page for this lesson, pencil, graph paper
PRIOR KNOWLEDGE	Average rate of change as change in output over change in input (Unit 2, Lesson 6). Plotting points. Subtracting negatives and simplifying fractions (Unit 1).
STANDARDS	NC Math 1 NC.M1.F-IF.6 and NC.M1.F-LE.1 (linear functions change by a constant rate); slope as the constant rate of a linear function, leading to NC.M1.A-CED.2 and F-IF.7.
KEEP OUT	No y = mx + b yet (Lesson 2). No parallel or perpendicular (Unit 4).

Learning goals

1. Say what slope is with both wordings: rise over run, and the rate of change, how much y changes for each step of x.
2. Find slope from a graph by counting, from a table by the constant change, and from two points by subtracting in the same order, and simplify the fraction.
3. Read the sign and size: positive climbs, negative falls, 0 is flat, vertical has no slope, bigger size is steeper.
4. Explain why any two points on a line give the same slope.

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
Slope	rise over run	The rate of change: how much y changes for each step of x.
Rise	change in y	Up or down; down is negative.
Run	change in x	To the right.
Positive, negative, zero	climbs, falls, flat	The sign is the direction.
Undefined	vertical line	Run 0; you cannot divide by 0.

> THE ONE SENTENCE TO SAY OUT LOUD
>
> Slope is rise over run: how much y changes for each step of x. Top is up or down, bottom is to the right. Same order both times.

Lesson timeline (40 minutes)

0:00 to 0:05	**Warm-up: the fraction returns.** Show the plant table from Unit 2, Lesson 6 and ask for the average rate of change from week 1 to week 5 (2 per week). Then ask for it from week 0 to week 2 on a straight-line table. Point out that a straight line gives the same answer on every stretch, so the number deserves a name: slope.
0:05 to 0:14	**Mini-lesson: rise over run on the grid.** Draw a climbing line through grid corners. Pick two points, draw the staircase, count up (rise) then right (run). Write the fraction and simplify. Repeat on a falling line and let the student discover that the rise is negative. Say: the run is always to the right; the rise carries the sign.
0:14 to 0:24	**Table and two points.** Same fraction, no picture: a table with constant change, then two points with the subtraction rule (second minus first, both times). Then the four cases on one grid: steep, gentle, falling, flat, and the vertical line with run 0.
0:24 to 0:35	**Practice.** The Count it yourself grids, then the interactive practice problems or Worksheet Parts A to D. Same buttons: Hint, Show next step, Reveal answer, Hide help. Listen for rise over run said out loud with the fraction simplified.
0:35 to 0:40	**Exit ticket.** Worksheet Part F or an index card: slope through (2, 1) and (6, 9); slope of the table 0, 3, 6 and 12, 6, 0. Success looks like 2 and –2 with rise and run shown.

Misconceptions to listen for

- Run over rise. The change in y is on top. Say output over input, the same as Unit 2.
- Mixed subtraction order. Second minus first on top and bottom, or the sign flips.
- Negative run. Count the run to the right. The rise carries the sign.
- Flat means no slope. A flat line has slope 0. The vertical line is the one with no slope.
- Not simplifying. 6/4 and 3/2 are the same slope. Simplify, then read it as up 3 for every 2 right.
- Steeper means bigger number. –6 is steeper than 4. Compare sizes for steepness, signs for direction.

Support and stretch

Support

Use graph paper and a colored pencil for the staircase. Keep both points on grid corners. Do tables with x stepping by 1 before tables with bigger steps. Keep a card with the fraction written in words: change in y over change in x.

Stretch

Give two points with fraction coordinates. Ask for a third point on the same line using the slope. Ask why the slope between (2, 3) and (5, 12) equals the slope between (5, 12) and (8, 21).

Where this goes next

Lesson 2: slope-intercept form, y = mx + b. The slope m takes its seat in the equation next to b, the y-intercept, and students graph a line straight from its equation.

> THE HABIT TO BUILD
> Every slope: two points, rise over run, second minus first both times, simplify, then say climbs or falls.