Writing y = rx

Students write the proportional equation y = rx, read it in plain English, use it forward and backward, find r from a table, a graph, and words, and see that every relationship can be written two ways.

TIME	25 minutes (one student with a parent or tutor)
WHO	7th grade, about age 12. Follows Lesson 4, Proportional Graphs.
MATERIALS	Student worksheet (PDF), the Deep Dive 5 page for this lesson (slider with equation, graph reading), pencil.
PRIOR KNOWLEDGE	The unit rate in tables, words, and graphs (Lessons 3 and 4); writing simple expressions (6th grade, NC.6.EE.2).
STANDARDS	NC.7.RP.2.
KEEP OUT	y = mx + b, slope, and intercepts. The equation here has one number, r, and nothing added.

Learning goals

1. Read y = rx as output equals unit rate times input.
2. Write the equation from a table, a graph, or words, using letters from the story.
3. Use the equation forward (multiply) and backward (divide).
4. See that the same relationship can be written two ways.

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
Equation	c = 3.20g	A math sentence with an equals sign.
Variable	c, g	A letter for an amount that can change.
r	3.20	The unit rate, next to x.

> THE ONE SENTENCE TO SAY OUT LOUD
>
> y = rx. The output equals the unit rate times the input.

Lesson timeline (25 minutes)

0:00 to 0:05	Warm-up. Say the thread sentence. Ask: how would you write always multiplies by the same number in math? Build y = rx together.
0:05 to 0:11	Gas. c = 3.20g. Forward for 12 gallons, backward for $48. Multiply, divide.
0:11 to 0:16	Slider. Table, graph, equation together. Then read r off the graph at x = 1 and answer the three questions.
0:16 to 0:22	Bus driver and practice. t = 2.5m. The practice problems or Worksheet Parts A and B.
0:22 to 0:25	Exit ticket. Worksheet Part C. Success looks like c = 7.50t written before the $45.

Misconceptions to listen for

- **rx means r plus x.** Side by side means multiply.
- **Always multiply.** Known output, wanted input: divide by r.
- **r is read anywhere on the graph.** Read it at an input of 1.
- **Only one equation is right.** Two unit rates, two equations; the story picks.

Support and stretch

Support

Keep a three-line card: find r, write y = rx, decide forward or backward. Read every equation aloud in words before using it.

Stretch

Give an equation with a fraction unit rate, like y = (2/3)x, and ask for a table and a graph. Ask the student to write both equations for a story and explain when each is useful.

Where this goes next

Lesson 6: what a point means. Every point on the graph is a small story, and two of them, (0, 0) and (1, r), are special.

> THE HABIT TO BUILD
>
> Find r first. Then the equation writes itself.