Connect the Dots: From Points to a Line

Students see why the dots of a linear rule make a line (every in-between input has one output, so it is a point on the same line), then learn when connecting the dots is honest: continuous versus discrete.

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 1 (what a function is, f(x), plotting points).
MATERIALS	Student worksheet (PDF), the Deep Dive 5 interactive page for this lesson, pencil, graph paper or the printed grid, a spreadsheet if available
PRIOR KNOWLEDGE	Lesson 1: a function gives one output for each input; f(x) notation; plotting (x, y). Unit 1: evaluating with decimals and negatives.
STANDARDS	Builds toward NC Math 1 NC.M1.F-IF.5 (interpret the domain of a function in context, including discrete and continuous) and NC.M1.F-IF.7 (graph linear functions). Slope and y = mx + b are deliberately saved for Unit 3.
KEEP OUT	No slope, no y = mx + b, no writing the equation of a line from a graph. Only: the points form a line, and the line stands for every input.

Learning goals

1. Evaluate a linear rule at an in-between input (a decimal or a negative) and plot the point, seeing that it lands on the line through the table's dots.
2. Explain, in plain English, that the line is all of the points of the rule at once, because a function gives one output for every input.
3. Decide whether a point is on a rule's line by checking that its y equals the rule's output for its x.
4. Sort situations into continuous (connect the dots) and discrete (separate dots) and give the reason: can the input be any number, or only whole things?

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
Line	the straight path through the dots	All of the points of the rule at once: every input with its one output, drawn together.
In-between input	x = 0.5, 2.25, –1.5	An input that is not a whole number. Feed it in like any other number.
Continuous	solid line	Every in-between input is real (time, temperature, distance), so connect the dots.
Discrete	separate dots	Only whole things are real (people, tickets, pizzas), so leave the dots separate.
Function	one output for each input	The promise that makes every input exactly one point.

> THE ONE SENTENCE TO SAY OUT LOUD
>
> Any input gives one output, so one point, and every point of the rule sits on the same line. Connect the dots only when the in-between inputs are real.

Lesson timeline (40 minutes)

0:00 to 0:05	**Warm-up: back to the dots.** Show the six dots of y = 2x – 1 from Lesson 1. Ask: "What is y when x is 0.5?" Let the student feed it in (y = 0). "Where would (0.5, 0) go?" Plot it. Repeat for 1.5 and 2.25. Ask what they notice: every new point lands on the same straight path.
0:05 to 0:13	**Mini-lesson: the leap.** Say it plainly: a function gives one output for every input, and the inputs do not stop at whole numbers. Every input is one point, and all of them sit on one straight path. So the line is not a guess: it is all of the points at once. Press Draw the line on the interactive page, then have the student type three in-between inputs of their own (a decimal, a negative decimal, a fraction) and watch each point land on the line. Then test a point that is off the line: is (1.5, 7) on y = 3x + 2? Only if its y matches the rule (it does not: 6.5).
0:13 to 0:22	**Continuous or discrete.** Two stories side by side: a tub filling at 3 gallons a minute, and tickets at $3 each. Ask the one question for each: can the input be any number? Time, yes, so connect the dots. Tickets, no, so the dots stay separate. Use the in-between box on the tickets grid to show that n = 2.5 gives no point. Do the sorting activity together, saying the reason out loud each time.
0:22 to 0:35	**Practice.** The interactive practice problems, or Worksheet Parts A to C. Same buttons: Hint, Show next step, Reveal answer, Hide help. Listen for the reason on every continuous or discrete call, not just the label.
0:35 to 0:40	**Exit ticket.** Worksheet Part E or an index card: (1) y = 2x – 1 at x = 3.5, find y and the point; (2) candle height over time, continuous or discrete and why. Success looks like: (3.5, 6), and continuous because any amount of time is real.

Misconceptions to listen for

- **The line is a guess.** Students think drawing the line is decoration. Show that every in-between input lands on it by computing the output. The line is the rule.
- **Connecting dots that should stay separate.** A graph of people, tickets, or pizzas is discrete. Ask: is 2.5 of these a real thing?
- **Leaving time or distance as dots.** Minute 2.5 is real. Any amount of time is real. Connect the dots.
- **Checking a point by its x only.** (1.5, 7) has an x that is fine, but its y does not match the rule. Both parts must fit.
- **Decimals feel like a different kind of number.** They are not. Feed 0.5 into the rule exactly as you would feed 5.
- **Wanting to name the steepness.** Some students will reach for slope. Hold it: Unit 3 gives it a name and a formula. Here it is enough to see that the path is straight.

Support and stretch

Support

Keep the inputs friendly at first: halves, then quarters. Plot on paper with a ruler laid across the dots so the student can see new points touching the ruler. For continuous or discrete, use the one question every time and say the answer as a full sentence: "the input can be any number, so it is continuous."

Stretch

Ask for an input that would land off the printed grid and have the student say where it would be. Ask what x gives $y = 4$ for $y = 2x - 1$ (solve it: $x = 2.5$) and check the point on the line. Ask for a story that is continuous in one input and discrete in another (a taxi: time is continuous, passengers are discrete).

Where this goes next

Lesson 3: domain and range, the inputs and the outputs. The continuous or discrete question returns as part of a reasonable domain. Later, Unit 3 measures the climb of the line and names it slope, then writes $y = mx + b$.

> THE HABIT TO BUILD
>
> Before connecting any dots, ask: can the input be any number, or only whole things? Say the answer and the reason out loud, every time.