Midpoint, Meeting in the Middle

Students build the midpoint formula from averaging on a number line, find midpoints on the grid, show the order does not matter, and find a missing endpoint by the step way and the equation way.

TIME	40 minutes (one student with a parent or tutor, or a small group)
WHO	Math 1 (algebra readiness), about age 12. Follows Unit 11, Lesson 1.
MATERIALS	Student worksheet (PDF), the Deep Dive 5 interactive page for this lesson, pencil, graph paper
PRIOR KNOWLEDGE	Mean of two numbers. Plotting points. Solving two-step equations (Unit 1). Distance (Lesson 1).
STANDARDS	NC.M1.G-GPE.6.
KEEP OUT	Points that divide a segment in other ratios. Perpendicular bisectors.

Learning goals

1. Find the midpoint of a segment by averaging the x's and the y's, writing the averages as stacked fractions.
2. Explain why the midpoint is an average and why the order of the endpoints does not matter.
3. Find a missing endpoint from the midpoint and one endpoint, by the step way and by the equation way.
4. Check an answer by finding the midpoint of the two endpoints.

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
Midpoint	halfway along	Average across, average up.
Bisect	cut in two equal parts	A 1 to 1 ratio.
Mean	add, divide by 2	The average.
Step way	take the step once more	Endpoint to midpoint to endpoint.

> THE ONE SENTENCE TO SAY OUT LOUD
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> Where is the middle? Halfway across, halfway up: average the x's, average the y's.

Lesson timeline (40 minutes)

0:00 to 0:05	Warm-up: number line. Halfway between 2 and 8. Between –4 and 10. How did you get it? The average.
0:05 to 0:15	Mini-lesson: the grid. Across and up separately. Jennifer and Jane. From the other end. The counting picture: half the step. Drag endpoints in the tool.
0:15 to 0:27	Backward. M(6, 2), A(1, 3): the step way, then the equation way, then the check. Then the negatives and decimals example.
0:27 to 0:36	Practice. The practice problems or Worksheet Parts B to D. Same buttons: Hint, Show next step, Reveal answer, Hide help.
0:36 to 0:40	Exit ticket. Worksheet Part F. Success looks like (4, 6) and (11, 1) with a named method.

Misconceptions to listen for

- **Subtract to find the midpoint.** Subtracting is for distance. The midpoint adds and halves.
- **Forget to divide by 2.** The average needs it.
- **Step back toward the known endpoint.** Continue past the midpoint, in the same direction.
- **Mixing x and y.** Do each direction separately.

Support and stretch

Support

Have the student draw the step across and up and count half of each before using the formula. For the backward question, draw arrows: endpoint to midpoint, then the same arrow again.

Stretch

Ask for the point one third of the way from (0, 0) to (9, 6). Ask where the midpoints of the two diagonals of a rectangle land (preview of Lesson 4).

Where this goes next

Lesson 3: perimeter and area from coordinates. Distance for every side, then add; and the box method for areas.

> THE HABIT TO BUILD
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> Average across, average up. Backward: take the step once more, then check.