Perimeter and Area from Coordinates

Students find perimeters by applying the distance formula to every side, find areas of rectangles and triangles from coordinates, check an altitude with slopes before using it as the height, and use the box method.

TIME	45 minutes (one student with a parent or tutor, or a small group)
WHO	Math 1 (algebra readiness), about age 12. Follows Unit 11, Lesson 2.
MATERIALS	Student worksheet (PDF), the Deep Dive 5 interactive page for this lesson, pencil, graph paper, calculator
PRIOR KNOWLEDGE	Distance (Lesson 1). Slope, parallel, and perpendicular (Unit 4). Area formulas for rectangles and triangles (elementary and middle school).
STANDARDS	NC.M1.G-GPE.4. The Extended Content Standards version (counting perimeter and area on the grid) is the starting point.
KEEP OUT	Heron's formula. Simplifying radicals. Areas of other polygons except by the box method.

Learning goals

1. Find a perimeter by finding every side length and adding, exact and to the hundredth.
2. Find the area of a tilted rectangle with the distance formula.
3. Check with slopes that a segment is an altitude, then find a triangle's area.
4. Use the box method for a shape with no easy height.

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
Perimeter	around	Add the sides.
Area	inside, square units	Length times width; one half base times height.
Altitude	the height	Perpendicular to the base; check with slopes.
Box method	box and subtract	For awkward shapes.

> THE ONE SENTENCE TO SAY OUT LOUD
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> Perimeter: every side, then add. Triangle: one half base times height, and check the height with slopes first.

Lesson timeline (45 minutes)

0:00 to 0:05	**Warm-up: count a rectangle.** (1, 1), (6, 1), (6, 4), (1, 4): perimeter and area by counting.
0:05 to 0:15	**Perimeter.** The pentagon, one side at a time with the polygon tool. Three fives and two square roots. Add.
0:15 to 0:28	**Area.** The tilted rectangle by distance. The triangle: check D on AB, check CD perpendicular, then one half of 15 times 5.
0:28 to 0:35	**The box method.** The small triangle, then set the pentagon as a challenge.
0:35 to 0:41	**Practice.** The practice problems or Worksheet Parts A to C. Same buttons: Hint, Show next step, Reveal answer, Hide help.
0:41 to 0:45	**Exit ticket.** Worksheet Part E. Success looks like 24, 37.5, and the two slope checks.

Misconceptions to listen for

- **Any side can be the height.** Only a perpendicular one.
- **Forget the one half.** A triangle is half of its box.
- **Count a slanted side.** Use the right triangle.
- **Add the corner pieces.** Subtract them from the box.

Support and stretch

Support

Have the student draw every right triangle under every side before computing. For the altitude, mark the right angle with a small square after the slope check.

Stretch

Ask for the area of the pentagon by splitting it into triangles from C instead of boxing it. Ask for the perimeter of the rectangle A(1, 2), B(6, 0), C(10, 10), D(5, 12).

Where this goes next

Lesson 4: proving shapes with coordinates. All three tools together: slope for parallel and perpendicular, distance for equal sides, midpoint for the diagonals.

> THE HABIT TO BUILD
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> Distance for every side. For a triangle, check the height with slopes before you multiply.