What a System Is, and Solving by Graphing

Students meet a system of two linear equations, learn that a solution must satisfy every equation (the intersection on a graph), solve by graphing with m and b, check in both equations, and see the limit that motivates the algebra methods.

TIME	35 minutes (one student with a parent or tutor, or a small group)
WHO	Math 1 (algebra readiness), about age 12. Follows Unit 5.
MATERIALS	Student worksheet (PDF), the Deep Dive 5 interactive page for this lesson, pencil, graph paper, ruler
PRIOR KNOWLEDGE	Graphing a line from m and b and rewriting into y = mx + b (Unit 3). Checking a point in an equation (Unit 2).
STANDARDS	NC Math 1 NC.M1.A-REI.6 (solve systems of linear equations, including by graphing) and A-REI.11 (the x-coordinate of the intersection is the solution).
KEEP OUT	Substitution and elimination (Lessons 2 and 3). Number of solutions (Lesson 4).

Learning goals

1. Say what a system of equations is and that a solution must make every equation true.
2. Solve a system by graphing both lines from m and b, reading the intersection, and checking the point in both equations.
3. Explain why the crossing point is the solution and why a point on only one line is not.
4. Recognize when a crossing cannot be read exactly and say that algebra is needed.

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
System of equations	two at once	All must be true together.
Solution of a system	works in every equation	The crossing point.
Intersection	where the lines cross	The one point on both.
Exact answer	algebra	For crossings off the grid corners.

> **THE ONE SENTENCE TO SAY OUT LOUD**
> A system is two equations at once. A solution has to work in every equation: on the graph, where the lines cross. Graph both, read the crossing, check in both.

Lesson timeline (35 minutes)

0:00 to 0:05	**Warm-up: two lines on one grid.** Graph $y = 2x - 1$ and $y = -x + 5$ together. Ask which points are on the first line, which on the second, and whether any point is on both. Name it: the intersection, the solution of the system.
0:05 to 0:14	**Mini-lesson: the meaning, then the method.** Check (2, 3) in both equations and (0, –1) in both. Say the rule: it has to work in every equation. Then the three steps: graph both, read the crossing, check in both. Do one with a rewrite.
0:14 to 0:24	**Read and check.** The three interactive grids, including the third where the crossing is off a grid corner. Let the student feel the limit, then say that Lessons 2 and 3 fix it.
0:24 to 0:32	**Practice.** The practice problems or Worksheet Parts A and B. Same buttons: Hint, Show next step, Reveal answer, Hide help. Every solution needs both checks written.
0:32 to 0:35	**Exit ticket.** Worksheet Part E. Success looks like yes with both checks, and (1, 3).

Misconceptions to listen for

- **A point on one line is a solution.** Both, or nothing.
- **Reading the crossing without checking.** A small graphing slip moves the point; the check catches it.
- **Guessing an off-corner crossing as a whole number.** Estimate, and say it needs algebra.
- **Graphing standard form directly.** Rewrite into y = mx + b first.

Support and stretch

Support

Use two colors for the two lines. Trace each line with a finger to the crossing. Keep systems whose crossing is a whole-number point until the last example.

Stretch

Ask for a system whose solution is (–1, 2). Ask what happens if the two lines are parallel (Lesson 4). Give a system with a fraction crossing and ask for the best estimate.

Where this goes next

Lesson 2: solving by substitution. Turn the two-variable system into one equation in one variable and solve it the Unit 1 way.

> THE HABIT TO BUILD
> Every solution of a system gets checked in every equation.