From a Line to a Region

Students see that a linear inequality in two variables is made true by a half-plane rather than a line, graph the boundary from m and b, apply the edge rule (dashed for strict, solid for or-equal), and check whether points are solutions.

TIME	35 minutes (one student with a parent or tutor, or a small group)
WHO	Math 1 (algebra readiness), about age 12. Follows Unit 4.
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 (Unit 3). Reading inequality signs, open and closed circles (Unit 1, Lesson 6). Plotting points (Unit 2).
STANDARDS	NC Math 1 NC.M1.A-REI.12 (graph the solutions to a linear inequality in two variables as a half-plane, excluding the boundary for strict inequalities).
KEEP OUT	Which side to shade is Lesson 2 (here the region is shown, not chosen). Systems are Unit 6.

Learning goals

1. Explain that an inequality in two variables is made true by a half-plane, not a line, and name the boundary line.
2. Graph the boundary from m and b and draw it dashed for $<$ and $>$, solid for $\leq$ and $\geq$.
3. Decide whether a point is a solution by putting it in, and locate it on the picture (in the region, on a solid edge, on a dashed edge, outside).

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
Solution	a point that makes it true	Put x and y in.
Half-plane	one side of a line	The region of solutions.
Boundary line	the edge	The line with an equals sign; m and b.
Dashed, solid	edge out, edge in	Strict versus or-equal, like open and closed circles.

> THE ONE SENTENCE TO SAY OUT LOUD
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> An equation gives a line. An inequality gives a region: one whole side of that line. Same boundary from m and b. Strict is dashed, or-equal is solid.

Lesson timeline (35 minutes)

0:00 to 0:05	Warm-up: one x, many y. Graph $y = 2x + 1$. Ask for y when $x = 1$ (3). Then ask: which y values make $y > 2x + 1$ true when $x = 1$? Let the student list several and mark them: a tower above the line.
0:05 to 0:14	Mini-lesson: the region. Every x has its tower; together they fill one side. Name it: half-plane. Name the edge: boundary line, the line with an equals sign, graphed from m and b. Then the edge rule with the two pictures side by side: strict is dashed, or-equal is solid. Tie it to the open and closed circles of Unit 1.
0:14 to 0:24	Point checkers and sort. The two point-checker grids: try a point in the region, on the edge (both versions), and outside. Then the dashed-or-solid sort, reading only the sign.
0:24 to 0:32	Practice. The practice problems or Worksheet Parts A to C. Same buttons: Hint, Show next step, Reveal answer, Hide help. Every point check must show the sentence.
0:32 to 0:35	Exit ticket. Worksheet Part E. Success looks like: yes and no (dashed edge); $y = –x + 3$, solid.

Misconceptions to listen for

- **The solutions are still the line.** They are a whole side of it.
- **Dashed means less than.** Dashed means strict, either direction. Solid means or-equal, either direction.
- **A point on a dashed edge counts.** It does not; the sentence comes out false.
- **Graphing the boundary differently.** It is the same m and b work as Unit 3.
- **Guessing the side from the picture.** Lesson 2 teaches the side. Here, check by putting the point in.

Support and stretch

Support

Build the towers physically: for x = 1, stack counters above the line. Keep boundaries with whole-number m and b. Use a colored pencil for dashed versus solid.

Stretch

Ask what happens to the region if the sign flips (the other side). Ask for an inequality whose region is below a given line. Ask whether a vertical boundary is possible (x > 3), previewing Lesson 2.

Where this goes next

Lesson 2: which side to shade. Solve for y, graph the boundary, dashed or solid, shade above for greater and below for less, and confirm with a test point, with the flip rule from Unit 1.

> THE HABIT TO BUILD
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> Boundary from m and b. Dashed or solid from the sign. Check a point by putting it in.