Which Side to Shade

Students learn one repeatable procedure for graphing a linear inequality in two variables, with the reasoning for shading (y greater is above, y less is below) and the test point as confirmation, including the flip rule and the vertical and horizontal special cases.

TIME	40 minutes (one student with a parent or tutor, or a small group)
WHO	Math 1 (algebra readiness), about age 12. Follows Unit 5, Lesson 1.
MATERIALS	Student worksheet (PDF), the Deep Dive 5 interactive page for this lesson, pencil, graph paper, ruler, colored pencil
PRIOR KNOWLEDGE	Solving an inequality for a letter, including the flip when multiplying or dividing by a negative (Unit 1, Lesson 6). Graphing from m and b (Unit 3). The half-plane and the edge rule (Lesson 1).
STANDARDS	NC Math 1 NC.M1.A-REI.12 (graph the solution set of a linear inequality in two variables as a half-plane).
KEEP OUT	Systems of inequalities (Unit 6). Here, one region at a time.

Learning goals

1. Run the five steps in order: solve for y with the flip rule, boundary from m and b, dashed or solid, shade above or below, test point.
2. Explain why y greater than the line is shaded above and y less is shaded below, using the same x and a bigger or smaller y.
3. Use (0, 0) as a test point in the original inequality to confirm the side, and recognize a disagreement as a sign of a missed flip.
4. Graph $x > a$ and $y \leq a$ by sight: vertical shaded right or left, horizontal shaded above or below.

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
Shade	color the half-plane	Above for y greater, below for y less.
Test point	(0, 0), usually	Into the original; true means its side.
Flip the sign	negative multiplier	Unit 1, Lesson 6.
Above, below	higher, lower at the same x	What greater and less mean.
Vertical, horizontal	x = a, y = a	Right or left; above or below.

> THE ONE SENTENCE TO SAY OUT LOUD
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> Solve for y, flip if you multiply or divide by a negative. Boundary from m and b. Dashed or solid. Above for greater, below for less. Test a point in the original.

Lesson timeline (40 minutes)

0:00 to 0:05	Warm-up: bigger y is higher. Graph $y = x + 1$. At $x = 2$ the line is at 3. Ask for points at $x = 2$ with a bigger y (2, 4), (2, 6) and mark them: all above. Say: y greater than the line is above the line.
0:05 to 0:16	Mini-lesson: the five steps. Do $y \leq 1/2\ x - 1$ all the way through, saying each step. Then $-2y < 4x - 6$: solve for y, flip, and show that the test point agrees. Then deliberately skip the flip and show the test point disagreeing. That is the point of the test point.
0:16 to 0:26	Special cases, then shade it yourself. $x > 3$ and $y \leq -2$ by sight. Then the five interactive grids: style, side, check, and the point checker with (0, 0).
0:26 to 0:36	Practice. The practice problems or Worksheet Parts A and B. Same buttons: Hint, Show next step, Reveal answer, Hide help. Require the test point sentence every time.
0:36 to 0:40	Exit ticket. Worksheet Part D. Success looks like the five steps in order and $y < 2x - 3$ graphed in words with the test point.

Misconceptions to listen for

- **Greater always means above.** Only once y is alone on the left. $2x + y > 5$ must be solved first.
- **Skipping the flip.** Multiply or divide by a negative and the sign turns. The test point is the safety net.
- **Testing in the solved version.** A flip mistake carries into it. Test in the original.
- **Using a test point on the line.** It tells you nothing. Pick (0, 0) unless the line passes through it.
- **Shading toward the test point regardless.** Shade its side only if the sentence came out true.
- **Vertical means slope 0.** A vertical line has no slope; it is $x =$ a number, and the side is right or left.

Support and stretch

Support

Give the five steps as a card. Color the test point before shading. Keep boundaries with whole-number m and b at first, and put the flip case last.

Stretch

Ask what happens if the boundary passes through (0, 0) (pick another test point). Ask for an inequality whose graph is the region below a given dashed line. Ask a student to write both an inequality and a story that produce a vertical shaded region.

Where this goes next

Lesson 3: match it and write it. Read a graphed region and write its inequality, and match an inequality to its graph by elimination using three clues: the boundary, the line style, and the shaded side.

> THE HABIT TO BUILD
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> Five steps, same order, every time. Lead with above or below; confirm with the test point in the original.