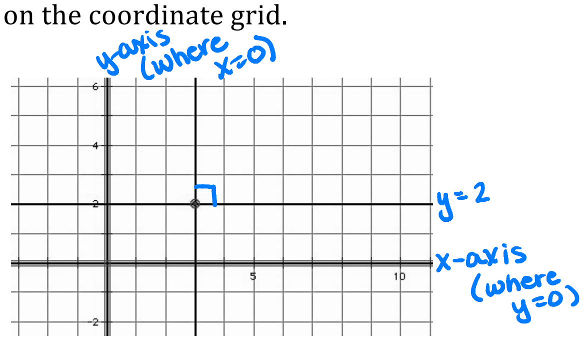
Lesson 2 Is It Right?

A Solidify Understanding Task

In *Leaping Lizards* you probably thought a lot about perpendicular lines, particularly when rotating the lizard about a given center a 90° angle or reflecting the lizard across a line.

In previous tasks, we have made the observation that *parallel lines have the same slope*. In this task we will make observations about the slopes of perpendicular lines. Perhaps in *Leaping Lizards* you used a protractor or some other tool or strategy to help you make a right angle. In this task we consider how to create a right angle by attending to slopes on the coordinate grid.

We begin by stating a fundamental idea for our work: *Horizontal and vertical lines are perpendicular.* For example, on a coordinate grid, the horizontal line $y = 2$ and the vertical line $x = 3$ intersect to form four right angles.



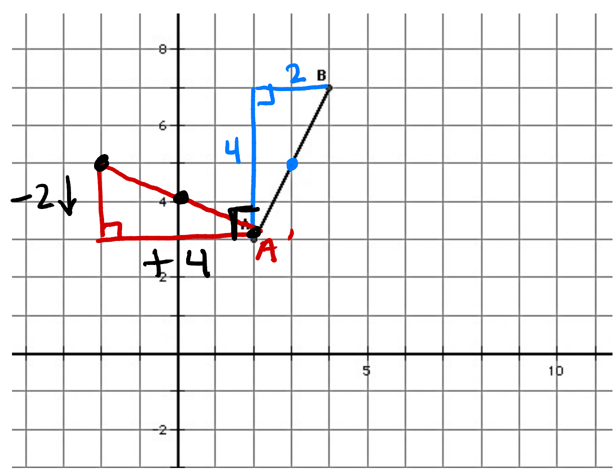
But what if a line or line segment is not horizontal or vertical? How do we determine the slope of a line or line segment that will be perpendicular to it?

<u>Experiment 1</u>

1. Consider the points A (2, 3) and B (4, 7) and the line segment, $\overline{AB}$, between them. What is the slope of this line segment?

   $m = \frac{\text{rise}}{\text{run}} = \frac{4}{2} = 2$

2. Locate a third point C (x, y) on the coordinate grid, so the points A (2, 3), B (4, 7) and C (x, y) form the vertices of a right triangle, with $\overline{AB}$ as its hypotenuse. C (2,7)



3. Explain how you know that the triangle you formed contains a right angle?

   Rise 4 is vertical, Run 2 is horizontal

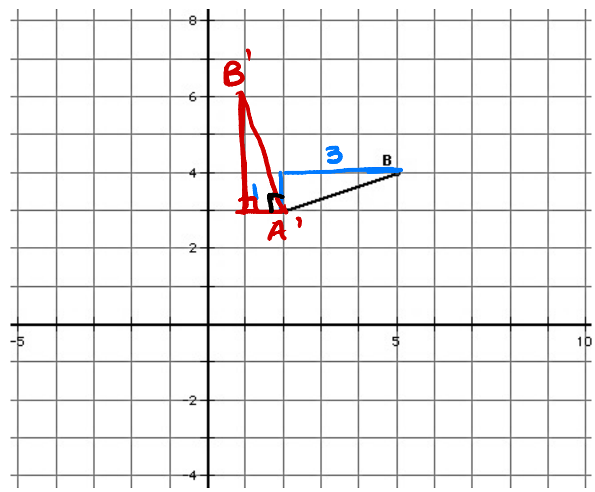
4. Now rotate this right triangle 90° about the vertex point (2, 3). Explain how you know that you have rotated the triangle 90°.

   Vertical line is now horizontal

5. Compare the slope of the hypotenuse of this rotated right triangle with the slope of the hypotenuse of the pre-image. What do you notice?

   $m = \frac{rise}{run} = \frac{-2}{4} = -\frac{1}{2}$ Slopes are opposite, reciprocals
   (sign) (flip)

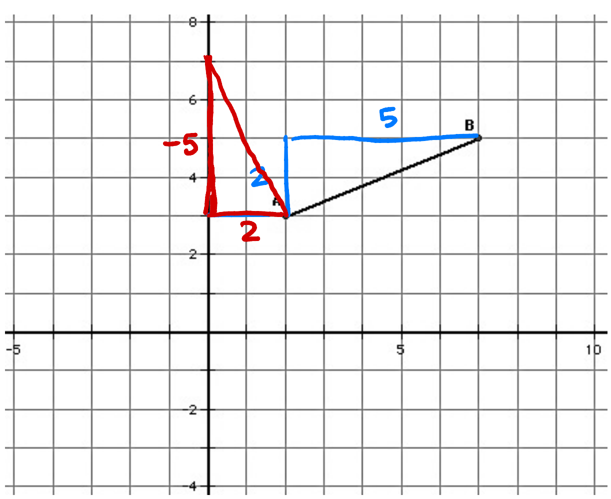
<u>Experiment 2</u>



Repeat steps 1-5 above for the points *A* (2, 3) and *B* (5, 4).

Slope of $\overline{AB}$ is $\frac{1}{3}$

slope of $\overline{A'B'}$ is -3



<u>Experiment 3</u>

Repeat steps 1-5 above for the points *A* (2, 3) and *B* (7, 5).

Slope of $\overline{AB}$ is $\frac{2}{5}$

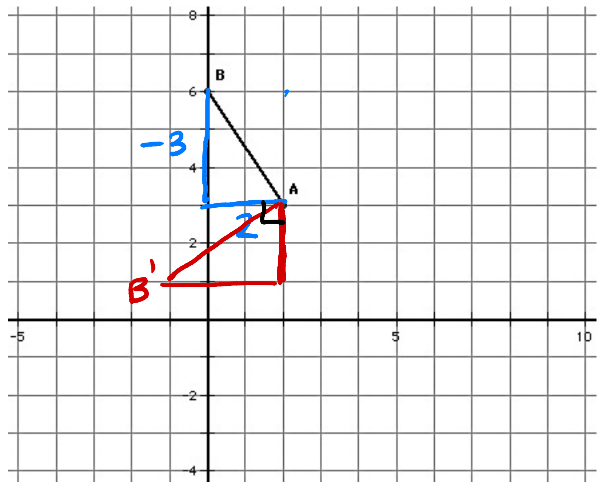
slope of $\overline{A'B'}$ is $-\frac{5}{2}$.

<u>Experiment 4</u>

Repeat steps 1-5 above for the points *A* (2, 3) and *B* (0, 6).

slope of $\overline{AB}$ is $\frac{-3}{2}$

slope of $\overline{A'B'}$ is $\frac{2}{3}$



Based on experiments 1-4, state an observation about the slopes of perpendicular lines.

While this observation is based on a few specific examples, can you create an argument or justification for why this is always true? (Note: You will examine a formal proof of this observation in a future module.)

$2 \cdot -\frac{1}{2} = -1$

$\frac{1}{3} \cdot -3 = -1$

$\frac{2}{5} \cdot -\frac{5}{2} = -1$

$\frac{-2}{3} \cdot \frac{3}{2} = 1$

The product of opposite repricals is -1.