How Slope Is Measured

Activity Notes

Objective: Students connect their intuitive sense of slope to specific calculations based on the coordinates of two points (the slope formula). They explore how the relative position of the two points is related to the value of the slope.

Student Audience: Pre-algebra/Algebra 1

Prerequisites: It helps if students know some basics about slope, such as what the difference is between positive and negative slope, what a line with a slope of 1 looks like, and so on. One way to learn these basics is to do other slope activities such as, The Slope of a Line and The Slope Game.

Sketchpad Level: Easy. Students manipulate a prepared sketch.

Activity Time: 25–35 minutes

Setting: Paired/Individual Activity or Whole-Class Presentation (use **Slope Measurement.gsp** in either setting)

Related Activities: The Slope of a Line, The Slope Game, and More Slope Games.

Prior to starting this activity, you may wish to have a discussion on how students could measure slope or steepness—of a hill or staircase, for instance. The objective isn't to get students to discover the rule, but rather to help them appreciate the problem.

Discuss $\overleftrightarrow{AB}$ versus $\overline{AB}$. Discuss why the slope of $\overline{AB}$ represents the slope of the entire line. Ask, "Can you have a steep step on a staircase that isn't steep? Or vice versa?" (No, because the steepness of each step is the same as the steepness of the staircase. You may wish to point out the similar triangles.)

Be sure to tell students whether to collect their data on paper or in the Sketchpad table. If you have printers, it may be convenient for students to collect their data in the sketch and print the sketch when they finish the activity.

SKETCH AND INVESTIGATE

Q1 Here is the completed table (with answers in bold):

(x_A, y_A)	(x_B, y_B)	*rise*	*run*	*Slope*
(2, 1)	(4, 2)	1	2	0.5
(4, 0)	(5, 3)	**3**	**1**	**3**
(−5, −1)	(−3, 4)	**5**	**2**	**2.5**
(−5, 3)	(5, 4)	**1**	**10**	**0.1**
(2, −3)	**(4, 3)**	6	2	**3**

Q2 Here is the completed table (with answers in bold):

(x_A, y_A)	(x_B, y_B)	*rise*	*run*	*Slope*
(2, 1)	(4, 0)	**−1**	**2**	**−0.5**
(1, −1)	(0, 4)	**5**	**−1**	**−5**
(−3, 6)	(−5, −1)	**−7**	**−2**	**3.5**
(3, 5)	**(−1, 2)**	−3	−4	**0.75**

Q3 Switching *A* and *B* makes no difference, since the line and the step are still the same.

Q4 When *B* is above and to the left of *A*, the slope is negative; when *B* is below and to the left of *A*, the slope is positive. If *rise* and *run* have different signs, the slope is negative. If they have the same signs, the slope is positive.

Q5 Here are all possible integer answers in the original sketch window (with answers in bold):

(x_A, y_A)	(x_B, y_B)	*rise*	*run*	*Slope*
(1, 1)	(3, 2)	1	2	0.5
(1, 1)	**(5, 3)**	**2**	**4**	0.5
(1, 1)	**(7, 4)**	**3**	**6**	0.5
(1, 1)	**(−1, 0)**	**−1**	**−2**	0.5
(1, 1)	**(−3, −1)**	**−2**	**−4**	0.5
(1, 1)	**(−5, −2)**	**−3**	**−6**	0.5
(1, 1)	**(−7, −3)**	**−4**	**−8**	0.5

Q6 They are all on the same line. They can be reached by starting from *A* and repeatedly moving up 1 unit and right 2 units or down 1 unit and left 2 units.

Q7 $slope = rise/run$

Q8 $rise = y_B - y_A$

Q9 $run = x_B - x_A$

Q10 $slope = (y_B - y_A)/(x_B - x_A)$

EXPLORE MORE

Q11 The slope is the same in either direction. If you go the opposite way, the rise and the run will be the opposite of what they were before, and the ratio will be the same.

Q12 For a horizontal line, $rise = 0$, and $slope = 0/run$, which is 0 for any value of *run*. For a vertical line, $run = 0$ for any value of *rise*, and $slope = rise/0$, which is undefined.

WHOLE-CLASS PRESENTATION

Use the sketch **Slope Measurement.gsp** to show how slope changes as you change the line. The *Step* button gives students a picture of rise and run as a "step." Ask students to visualize the subsequent steps on this staircase, and use the *Staircase* button to show them.