Making Sense of Slope

Overview

Prerequisite Skills:
- **Plot points on a coordinate plane**
- **Basic understanding of slope.**

Learning Goals:
- Students will demonstrate how to find multiple points on a line using similar triangles or the ratio of $\frac{vertical\ difference\ between\ points}{horizontal\ difference\ between\ points}$
- Students will demonstrate understanding of slope as a ratio of $m = \frac{vertical\ difference}{horizontal\ difference} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$

Common Core Standards:
- Use similar triangles to explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane. (CCSS: 8.EE.6)
- Describe the connections between proportional relationships, lines, and linear equations. (CCSS: 8.EE)

Materials:
- Graphing Lines PhET simulation (this link only opens the Slope tab)
- Making Sense of Slope Activity sheet
- Exit Ticket

Estimated Time:
Approximately 50 minutes

Making Sense of Slope

Warm Up/Simulation Introduction	**5 minutes**

1. Open the Phet Simulation Graphing Lines
Explore the simulation. Be prepared to share at least two discoveries you have made and at least one question/wondering you have.

Discoveries
1.
2.

Question/wondering:

Teacher will…	***Students will…***

● Encourage students to take a few minutes to explore the Graphing Lines simulation, letting them know they will be comparing slope to vertical and horizontal difference between points.
● Circulate the room and ask students:
  ● What does the equation in the top-right corner mean? What information does it show when expanded?
  ● What do you notice about the coordinate boxes at the bottom of the screen?
  ● How does the slope on the graph compare to the slope shown in the expanded box?
  ● What do the blue arrows on the graph show? How are they connected to the information in the slope equation box?
 	
  ● Remind students they will be asked to share what they wrote down for discoveries and wonderings.
	● Explore the simulation, become familiar with options in sim
	● Respond to teachers' informal questioning
	● Record at least two discoveries and a question/wondering from the exploration in math notebook

Warm Up Debrief	**5 minutes**
Teacher will…	***Students will…***
● Ask students to share what they discovered in their exploration of the sim ● Remind students to listen carefully and share something new (something another student has not already shared) ● Ask students to share wonderings - ask other students to offer help ● Ensure each of the features of the sim have been discussed	● Share discoveries not already shared ● Share wonderings or questions ● Share ideas about questions from other students
Guided Exploration	**20 minutes**
Teacher will…	***Students will…***

● Distribute [activity sheet].
● Encourage students to to write in complete sentences
● Circulate through the room asking questions such as:
  ○ How are the points you chose related to the numbers in the slope calculation?
  ○ What do the blue arrows show?
  ○ Why are the numbers associated with the blue arrows sometimes negative and sometimes positive?
  ○ What causes the coordinate boxes to turn from white to black?
	● Complete the activity sheet with a partner (#1-5)
	● Ask for help as needed
	● Write in complete sentences
	● Engage with the teacher when questions are asked

○ Can we predict more points beyond the graph using the idea of slope or similar triangles? ○ How is the slope of a line related to lengths shown in blue? ○ What makes a slope positive or negative? ○ What happens when the points are horizontal or vertical from each other? How does that relate to the slope of a horizontal or vertical line? ○ How are the points you chose used in the equation for slope?	

Guided Exploration Debrief/Summary	**10 minutes**

Ask as many or few of these questions as works for your class. The guiding principle is to help students make the connection between the ratio of vertical change to horizontal change from one point to another being the slope of the line containing those points.

$$m = \frac{vertical\ difference}{horizontal\ difference} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

- What connection can you make between the sides of the triangle you created in #3 and the slope of the line?

(The ratio of the sides of the triangle you just drew represents the ***slope*** of the line. The vertical side of the triangle represents the difference in the y-coordinates or vertical difference and the horizontal side represents the difference in the x-coordinates or horizontal difference.)

- What connection can you make between the sides of the triangles you created in #4 and the slope of the line?
- Would that be true of any triangles formed from any two points on this line? Why or why not?
- What connection can you make between these triangles and slope?
- Would it be true for any two points on any other line compared with this line?

(Yes, if the lines had the same slope.)

- What do you notice about positive and negative values for the horizontal and vertical differences between the points?

(If the slope is negative, the horizontal and vertical differences have opposite signs. If the slope is positive, the horizontal and vertical differences have the same sign.)

- What sense can we make of the slopes of horizontal and vertical lines?

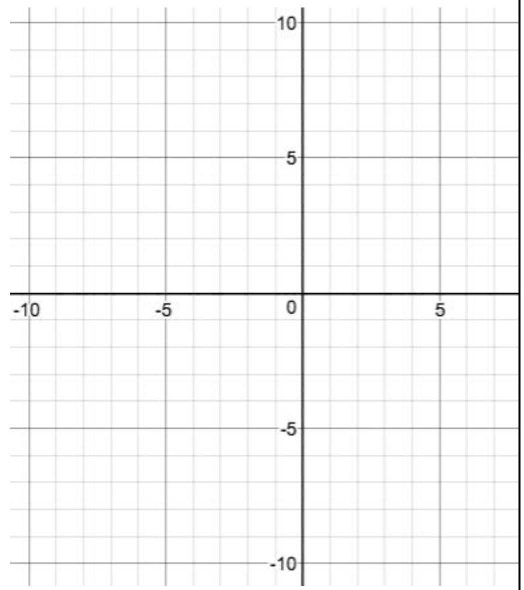
(In a horizontal line, the vertical difference is 0. Since 0 divided by any non-zero number is 0, the slope is 0. In a vertical line, the horizontal difference is 0. Since dividing by 0 is undefined, the slope is undefined.)

Exit Ticket	5 minutes

Name:________________________________ Date:__________ Period:_________

Exit Ticket - Making Sense of Slope

Draw a line (not vertical or horizontal) on the graph. Choose two points on the line. ***Show how*** to find the slope of the line by forming a right triangle with the points you chose being the endpoints of the hypotenuse.



Going Forward

Teacher should continue to make connections between slope (m) and the ratio of

$$m = \frac{vertical\ difference}{horizontal\ difference} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

Any lines with the same slope are parallel <=> any parallel lines have the same slope

Continue to discuss lines with positive slope, negative slope, zero slope, and undefined slope.

Make visual and computational connections as often as needed.