Exploring Slope

PRE-PLANNING

PRIOR KNOWLEDGE

- Determine if a graphed line has a positive, negative, zero, or undefined slope
- Know that any two points define a line
- Know that coordinate points have two components, x and y

LEARNING GOALS

- Explain how the slope of a line is computed
- Determine the slope of a graphed line
- Calculate the slope of a line given two points on the line

Common Core Standards	Common Core Practices
CCSS.Math.Content.8.EE.B.6 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*; derive the equation y = mx for a line through the origin and the equation *y = mx + b* for a line intercepting the vertical axis at *b*. CCSS.Math.Content.HSF.LE.A.1.a Prove that linear functions grow by equal differences over equal intervals.	1. Make sense of problems and persevere in solving them 2. Reason abstractly and quantitatively 5. Use appropriate tools strategically 7. Look for an make use of structure

MATERIALS

- PhET *Graphing Lines* simulation: https://phet.colorado.edu/sims/html/graphing-lines/latest/graphing-lines_en.html
- Computers/tablets for each student
- Notecards for each student
- "Exploring Slope" Activity Sheet for each student (see below)

LESSON CYCLE

WARM-UP *5 minutes*

Activate prior knowledge by leading a discussion or having students journal about the following questions:

1. What does slope measure about a line?
2. What are the four different types of slope? What do these types tell us about the appearance of the line?

INTRO *7 minutes*

Teacher will…	*Students will…*
• Distribute and collect notecards. • Distribute activity sheets.	**Explore** the Slope screen of the sim and write down 1–3 questions on a notecard.

GUIDED EXPLORATION *15 minutes*

Teacher will…	*Students will…*
• **Circulate the room** to be available for questions and ask probing/pushing questions, such as: 1. How does the slope calculation relate to the type of slope? 2. Why are the tickers and the points on the line the same color? 3. Compare your sketches with your neighbor. What do they	Work on the **front** of the activity sheet while interacting with the Slope screen of the sim.

	#2–3 Pair-Share: Have students turn and share with their partner their answers to questions 2–3. Instruct students to collaborate on their response to **#**4. Call on some pairs to share their response with the class.	**Discuss** #2–3 with their partner. **Collaborate** to define slope in #4. Be attentive when sharing out #4. Update or modify answer to #4 based on class discussion. Continue working on the back of the activity sheet, discussing #5-6 with partners.
	#7-8 Pair-Share: Have students turn and share with their partner their answers to questions #7-8. Call on some students to share with the class.	**Share** with their partner their answers to question 7.
	DISCUSSION *15 minutes*	
	Teacher will… • Facilitate a class discussion to bridge an understanding across representations. Remind students to close their laptops or turn around so that the sim does not distract them from listening. Use an established teaching strategy such as popcorn discussion (one student answers, calls on the next student to talk), think-pair-share (pose question, allow time to think, turn and talk to partner), or group discussions (print out questions and have groups talk to each other and write down consensus to share aloud with class). Sample questions include: 1. What is the connection between the top of the fraction and the graphed line (or points on the line)? 2. What is the connection between the bottom of the fraction and the graphed line (or points on the line)? 3. Why did some lines have a slope that was not a fraction? 4. Which lines don't have a slope at all? Why don't they have a slope? What did the slope equation look like? 5. What is the relationship between lines with the same slope? (Refer to #5–6.) 6. Why is it useful to have a formula to calculate slope?	*Students will…* Share responses to discussion questions.
	• Redistribute notecards to individual students. Facilitate a discussion about notecards: 1. Did anyone answer a question that they had at the beginning of the activity? What was it? 2. Did anyone *not* answer a question? Share out and call on someone who can answer it.	Share out answered and unanswered questions and call on another student who can answer.

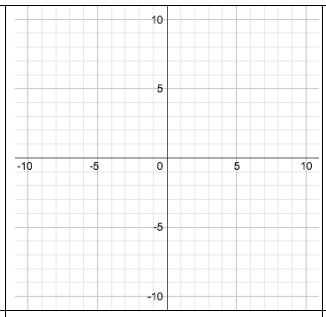
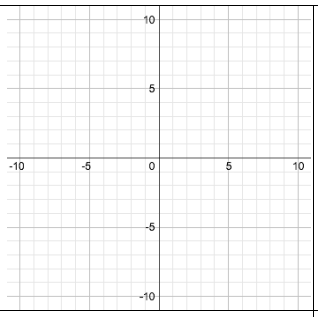
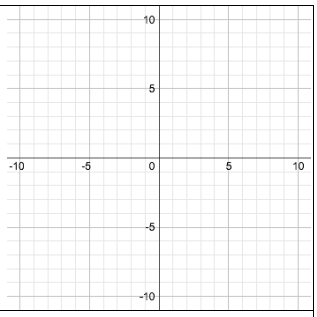
Name: _____ **Class:** _____ **Date:** _____

Exploring Slope

Learning Goals

- Explain how the slope of a line is computed
- Determine the slope of a graphed line
- Calculate the slope of a line given two points on the line

1. **Explore** the slope screen for 5 minutes and write down 1–3 questions that you have.
2. **Create** three lines with different slopes. Sketch your lines and complete the table below.

	1	2	3
Sketch			
Coordinates of two points on line	(,) and (,)	(,) and (,)	(,) and (,)
Calculate slope	$m = \frac{\square - \square}{\square - \square} = \frac{\square}{\square}$	$m = \frac{\square - \square}{\square - \square} = \frac{\square}{\square}$	$m = \frac{\square - \square}{\square - \square} = \frac{\square}{\square}$
Type of slope	☐ Positive ☐ Negative ☐ Zero ☐ Undefined	☐ Positive ☐ Negative ☐ Zero ☐ Undefined	☐ Positive ☐ Negative ☐ Zero ☐ Undefined

3. In the fraction that represents slope, describe how the **top** and **bottom** numbers (numerator and denominator) relate to the graph.

4. Compare with your responses for **#2–3** with your partner. Write a **description of slope** that relates the fraction and the graph:

Amanda McGarry 9/12/14 1:41 PM
Comment [1]: If there are not enough computers for each student to work individually, students can share a device and work in pairs, alternating who is "driving" sim use. Periodically check in with the class and remind them to switch users.

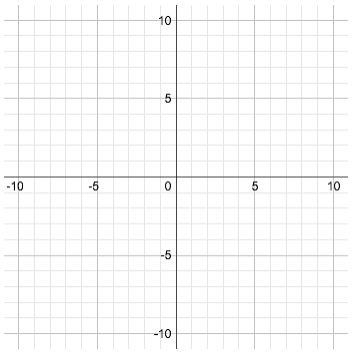
After students wrote their questions on a notecard, collect these for the concluding discussion.

Amanda McGarry 9/12/14 1:41 PM
Comment [2]: Circulate the room to be available for questions and ask probing/pushing questions, such as:
1.How does the slope calculation relate to the type of slope?
2.Why are the tickers and the points on the line the same color?
3.Compare your sketches with your neighbor. What do they have in common? What is different about them?

Amanda McGarry 9/12/14 1:41 PM
Comment [3]: #2-3 Pair-Share: Remind students to be discussing this with their partner before writing anything to #4.

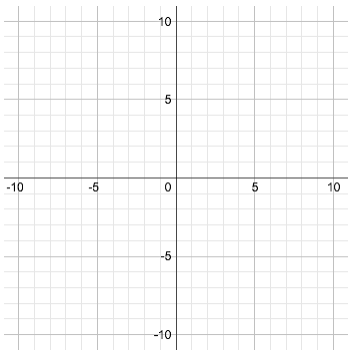
Once students have finished, ask students to either turn their computers around or close them half way so they aren't distracted while we are talking. Direct them to the sim that is projected on the board and have students share out their answers to #4.

5. Use the Save Line feature to find two *distinct lines* whose slopes are the same. Sketch both lines and record your findings below.

Sketch both lines	**Coordinates of two points on each line**	**Calculate slope**	**Observations** to discuss with your partner
	Line 1 (,) and (,)	m = $\frac{\square - \square}{\square - \square} = \frac{\square}{\square}$	
	Line 2 (,) and (,)	m = $\frac{\square - \square}{\square - \square} = \frac{\square}{\square}$	

Amanda McGarry 9/12/14 1:41 PM
Comment [4]: Be sure students are discussing their findings here! #5-6 are critical for seeing the same slope between parallel and concurrent lines.

6. Find two different sets of points on the same line. Sketch the line and record your findings below.

Sketch	**Coordinates of two points on each line**	**Calculate slope**	**Observations** to discuss with your partner
	Line 1 (,) and (,)	m = $\frac{\square - \square}{\square - \square} = \frac{\square}{\square}$	
	Line 2 (,) and (,)	m = $\frac{\square - \square}{\square - \square} = \frac{\square}{\square}$	

7. Calculate the slope of a line between the points (-5, -3) and (1, 6).

Amanda McGarry 9/12/14 1:41 PM
Comment [5]: Note interesting strategies that students use to answer #7. Do they use the sim to answer this? Do they make a sketch? Do they use the formula? Make note of student responses so you can be sure to call on a variety of students later.

8. Describe how to calculate the slope of a line between any two points.

Amanda McGarry 9/12/14 1:41 PM
Comment [6]: #7-8 Pair Share: A document camera may be useful here- place the student's work under the camera while they explain their thinking.

Amanda McGarry 9/12/14 1:41 PM
Comment [7]: Now that students have finished their exploration, distribute the original question notecards. Ask students about questions they had that they answered, and if there are any unanswered questions that others could help answer.