Making Sense of Slope

Grade Level: 6-9

Time Required: 1-2 Class Periods

Materials

Marbles or Ball Bearings
PVC pipe cut into various lengths
Curved tubing (optional)
A class set of the same text books
Stop watches or other timers
Measuring tape or yard sticks
Graph paper
Colored pencils
This problem set

Directions for teachers

I have used this lesson as a way to introduce and/or reinforce what students know and understand about slope.

I believe in stressing that slope is a rate of change and that slope of linear equations is a constant rate of change (more on this later).

Allow students time to play with the materials before getting into the lesson because, quite frankly, they're going to want to play with them anyway.

After allowing students to play with the materials explain to them that today they will be conducting experiments to discover something called slope. Most students will be familiar with how to calculate speed using distance and time from prior grade levels. Take a moment to remind them of this.

Place students in groups of 2-3 and pass out sections of PVC pipe and measuring tape. Have students measure their lengths of pipe and record their measurements on the accompanying sheet.

Once all measuring has taken place pass out stop watches and take a moment to teach students how to start, stop, and reset the watches. Trust me on this one. It will save tons of headache later.

After students have done all of their preliminary work they can begin calculating the speed that the marbles travels through the lengths of various sections of pipe and recording the information on their tables.

Once students have gone through several sections of pipe have them repeat the process while varying the height of their stack of books.
Varying the height will change the grade and essentially the speed. Students will later see the natural connection between smaller slopes and lines with smaller grades and larger slopes and lines with larger grades.

I suggest having students vary the height of their stacks of books from between one and seven books so they can see how a drastic change in steepness creates a proportionally drastic change in speed.

Once students reach the problem set I recommend that the teacher allow the students to work in groups to discover some of the basic similarities and differences. Bring the groups back for whole group discussion if a similar problem is encountered by several groups of students.

Making Sense of Slope

Name: _____ Date: _____ Period:_____

Today you will be conducting an experiment to make sense of a mathematical concept called slope. While conducting the experiment pay particular attention to the orientation of your PVC pipe, the height of your stacks of books, and any changes that may occur in speed.

Height of stack	Length of PVC pipe (inches or centimeters)	Time to travel PVC pipe (seconds)	Speed of marble or ball bearing (inches per second or centimeters per second)

Making Sense of Slope

Name: _____ Date: _____ Period:_____

Answer the following questions on your own paper and on graph paper. Be sure to answer your questions with complete sentences.

1. Choose 3 different speeds from your table. Write three formulas using each of the different speeds. Be sure to identify what each variable, coefficient, and constant represents in your formulas.
2. Write a general formula that can be used to calculate the distance that an object will travel if the speed that it is traveling is known. Be sure to define all variables.
3. Use the three formulas from question 1 to create function tables of the first 5 whole number input values and their corresponding outputs. Be sure to define the variables represented in your tables.
4. Graph each of your three linear functions on the same coordinate plane. Represent each using a different color.
5. What is the relationship between the steepness, or grade, of the lines in your graph and the speed in their related functions?
6. Based on your explanation from problem 5 what do you think the graph of a function with a speed or slope or zero would look like over a time of 10 seconds? Sketch what you have described. Justify your explanation and sketch.
7. Does the drawing of your function look exactly like the real world set up of your experiment or does it look different? How is it similar or different? What could be the reason that your set up does or does not resemble your graph?
8. In what real world situations would you have a constant positive speed? A constant negative speed? A speed of zero? What do you think these would look like graphed on the coordinate plane ?
9. Summarize what you have learned about slope in this experiment.

1. Choose 3 different speeds from your table. Write three formulas using each of the different speeds. Be sure to identify what each variable, coefficient, and constant represents in your formulas. Formulas should essentially all be in the slope intercept form. Teachers may or may not opt to use the initial height of student tubes as a y intercept.
2. Write a general formula that can be used to calculate the distance that an object will travel if the speed that it is traveling is known. Be sure to define all variables. Again, students should essentially be writing the slope intercept form of a line.
3. Use the three formulas from question 1 to create function tables of the first 5 whole number input values and their corresponding outputs. Be sure to define the variables represented in your tables. Students should be using time as an input and distance as an output.
4. Graph each of your three linear functions on the same coordinate plane. Represent each using a different color. Check students' papers.
5. What is the relationship between the steepness, or grade, of the lines in your graph and the speed in their related functions? Students should notices that the grade of the lines increase as the speed of the marble increases. The same is true for decreases in grade.
6. Based on your explanation from problem 5 what do you think the graph of a function with a speed or slope or zero would look like over a time of 10 seconds? Sketch what you have described. Justify your explanation and sketch. Students should recognize that a line with a slope of zero should be horizontal. If they cannot see this on their own they may place a marble in one end of the tube and hold it horizontal. Since the marble cannot move they should understand that a slope of zero implies a horizontal line.
7. Does the drawing of your function look exactly like the real world set up of your experiment or does it look different? How is it similar or different? What could be the reason that your set up does or does not resemble your graph? Students should notice that the drawings of their functions have an upward positive slope and their actual real world set ups are sloped downward. Explain to students that in a 2-d representation, all positive slopes tend up and to the right and negative slopes tend down and to the right.
8. In what real world situations would you have a constant positive speed? A constant negative speed? A speed of zero? What do you think these would look like graphed on the coordinate plane ? Several examples are

possible. Students may mention a runner or a car maintaining a constant speed. They may mention the same runner or car slowing down for negative speeds. They should mention a body at rest for a speed or slope of zero.

9. Summarize what you have learned about slope in this experiment.
Answers will vary.

I am interested in any improvements or revisions to this task. Please email me at milesmath@gmail.com if you decide to use, change, or improve upon this assignment.