An Algebra I Lesson on Slope

I. General Information

Subject: Algebra I
Unit Name: Analyzing Linear Equations
Lesson Topic: Slope
Teacher's Name: Skip Tyler
Grade Level: 9th and 10th
Number of Students: 25

Lesson Goal: The student will be able to (TSWBAT) understand and apply slope to linear equations and the real world.

II. Lesson Objectives

Obj1 TSWBAT define slope in three different ways. (Knowledge)

Obj2 TSWBAT identify the slope of a line as positive, negative, zero, or undefined. (Knowledge)

Obj3 TSWBAT explain how to determine the slope of a line given two points. (Comprehension)

Obj4 TSWBAT construct a graph given the slope and a point on the line. (Application)

Obj5 TSWBAT illustrate and analyze real world problems involving the definition of slope (Analysis)

III. Prerequisite Skills

The student must have an understanding of the basic concepts of a coordinate plane. Specifically, students must comprehend definitions covered in section 5-1 of the textbook (origin, x-axis, y-axis, x-coordinate, y-coordinate, ordered pair). Finally, students must understand the procedure for graphing ordered pairs on a coordinate plane.

The student must have a basic understanding of the computer application NIH Image. Familiarity with the tools associated within the software include measuring and recording data.

IV. Statement of Lesson Objectives (1 minute)

Prior to the beginning of this lesson, the lesson objectives will be written in the front of the classroom on a dry erase board and discussed with the students.

V. Lesson Introduction (10 minutes)

An advance (comparative) organizer of two traffic signs will be displayed on an overhead (included in Section X, Material A). This introductory activity will be used to engage the students in a real world application of slope. Students are given 1 minute to individually describe, identify, and analyze the meaning of the sign. Student responses are discussed and listed on the board in a brainstorming activity. After a "general rule" has been decided upon, students are shown another advance organizer (Section X, Material B) containing different road signs. Students must determine if they pertain to the concept of slope. This activity allows students to develop their own definition and concept of slope in a non-mathematical manner.

VI. Lesson Activities

Obj1 Obj2: Activity #1: Definitions and Identifications (15 minutes)

A. Students will be provided definitions (topics listed below) on the dry erase board. These definitions will be briefly discussed and modeled for the students.
   Slope defined as steepness
   Slope defined as rise over run
   Slope defined as a formula
   Positive, Negative, Zero, and Undefined Slope

B. Students will be asked to explain the relationship between the graph of a line and its slope. Students will be called to the board to draw a random line for class analysis.

Obj3: Activity #2: Hands On Activity – Geoboard (15 minutes)

A. The 25 students are split into 12 groups (with one group having 3 members). Each group is given a number from 1 to 12, a Geoboard, and rubber bands. (Close monitoring will ensure that no rubber bands get flicked towards the teacher!)

B. The following slopes will be displayed on the dry erase board for groups to graph on their Geoboard.

1. $m = 2$
2. $m = -1/2$
3. $m = 3/4$
4. $m = 0$
5. $m =$ undefined

C. The teacher will demonstrate the first problem with the assistance of one of the groups. The remaining problems will be completed and shown simultaneously for class observation and comparison. Groups will verbally identify each line as increasing, decreasing, horizontal, or vertical.

D. Upon completion of the five examples, each group creates their own line using their rubber band and Geoboard. Their board is passed in a clockwise order to the other groups. Each group is responsible for determining the slope of the line and recording it for class discussion.

E. Each group is responsible for giving the slope of a different group until all have been answered. Groups check their results with others for accuracy and correctness. Groups are dismantled and supplies are retrieved.

Obj4 Activity #3: Graphing Lines (10 minutes)

A. The teacher will demonstrate how to draw a line on a coordinate plane given the following slope and a point.

$$m = 2/3, (2, 1)$$

B. Students will be given a worksheet with four problems to solve (see Section X, Material C). Students will be instructed to complete the problems individually. During this time, the teacher is circulating among the students helping them develop their skills and assisting them with their questions.

C. Individual students draw their answers on an overhead version of the worksheet. Students verify the correctness of the solutions.

Obj5 Activity #4: Real World Application (25 minutes)

A. Students are given a worksheet titled Public Access: Slopes for the mathematically inclined. The students move to the mathematics computer lab and sit at their assigned station and participate in an example of how slope is used in the real world.

B. Students are given approximately 20 minutes to complete the activity (after time is lost due to travel and set up). Each student records his or her results on his/her worksheet.

Lesson Modification

Providing written notes and overheads to students who have a visual and/or physical disability can alter this lesson. Accommodations can be made for students with special needs as explained within the individual students' Individualized Education Plans. Problems can be altered in difficulty to match the varying level of the students

Problems using a manipulative can be done with worksheets if the materials are not available. In addition, the real world applications can be done without a computer by computing the slope of steps and/or ramps on campus.

VII. Lesson Closure (10 minutes)

The lesson closes with a review of the computer lab application. Students are asked to determine which of the ramps are illegal and must prove and explain their decision.

Students are asked to adapt the computer technique to the real world. They are asked, "How would you determine the slope of a ramp without the use of a computer?" These proposals allow students to synthesize the knowledge they have been creating.

VIII. Lesson Assessment

Formative Assessment: Students are assessed during the lesson based on their classroom performances. These assessments are completed through teacher observations, peer questioning, and groupwork during the activities.

Summative Assessment: The following questions will be given as a mini-quiz during the next class meeting to evaluate the summative assessments.

Obj1 1. Describe how the slope can be determined three different ways.

Obj2 2. Draw a line that has
   a. a positive slope.
   b. a negative slope.
   c. a zero slope.
   d. an undefined slope.

Obj3 3. Find the slope of the line given the points (3, -4) and (1, 2).

Obj4 4. Draw the graph of a line with slope equal to -1 crossing through the point (-3, -2).

Obj5 5. Describe the technique that would enable you to determine the slope of a given portion of road. Draw a diagram to go along with your explanation.

IX. Materials and Equipment

The following are the materials and equipment used throughout the lesson. Worksheets, Overheads, and Activity Sheets are listed in Section X.

Equipment:

Overhead
iMac computer with NIH Image application software
Geoboard

Materials:

Advance (Comparative) organizer (Material A)
Advance (Comparative) organizer (Material B)
Graphing equations given slope and a point (Material C)
Public Access worksheet (Material D)
Rubber bands
Overhead markers
Paper
Pencil
Brain!

X. Handouts and Teaching Materials

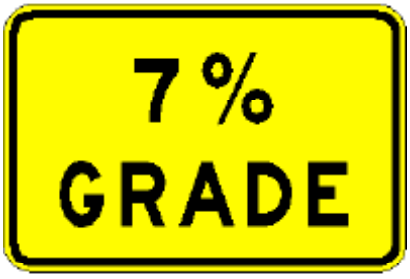
Material A

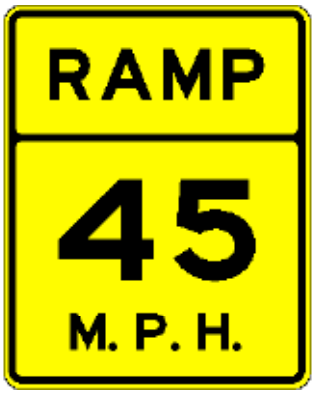
What is the purpose of this road sign?

What does the 6% represent?

Material B

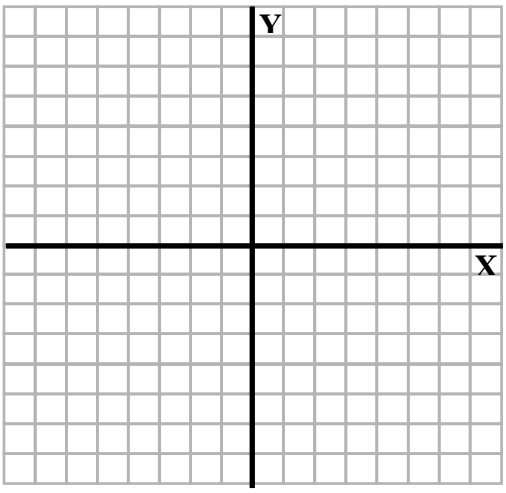
Which signs represent slope?



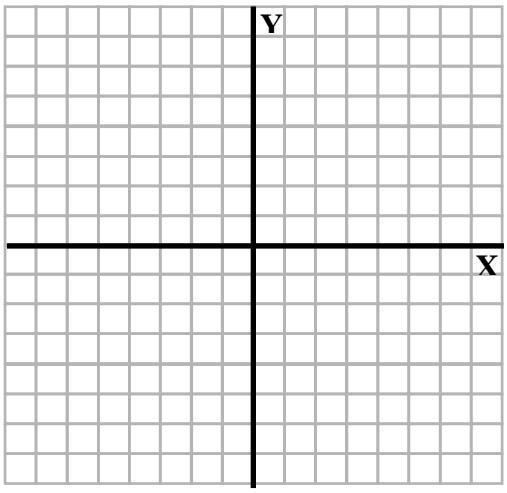


Material C

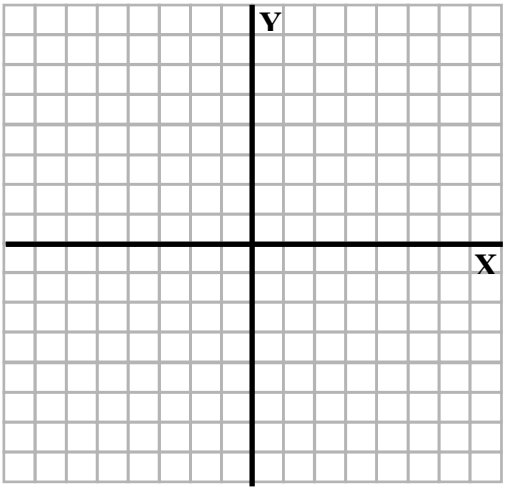
Use the coordinate planes to draw a line given the information listed below.



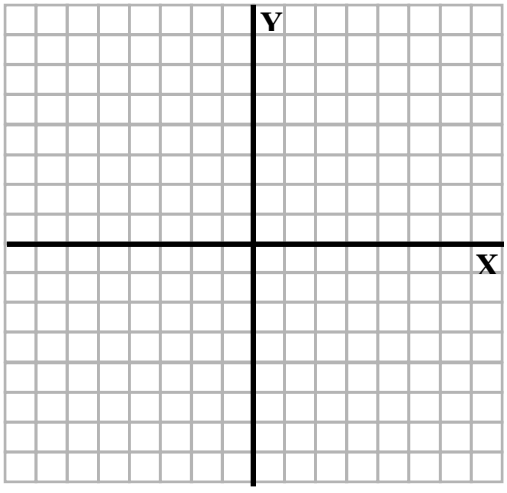
1. m = 2, (-2, 1)



2. m = -3, (1, 5)



3. m = -1/4, (0,2)



4. m = 0, (-1, -2)

Material D

Public Access

Name_____ **Pd.**___

Slopes for the mathematically inclined.

The engineering firm you work for has been hired to check public buildings for correct wheelchair access. You have been assigned to evaluate existing wheelchair ramps and look at steps that need to be converted to ramps.

Evaluating ramps

Slope is calculated by measuring the height (rise) and the length (run) of any part of the ramp. The slope is the ratio of the rise to the run.

The law in Virginia says wheelchair rates cannot have a slope greater than "1 in 12". This means that for every 12 inches of run, there can't be more than 1 inch of rise.

Open NIH Image. Go to **File** and select **Open**. Click the Desktop button and select Ramps from the REVAMP folder. These images show each of the wheelchair ramps.

1. What percent slope would 1 in 12 be equal to?_____

   rise/run x 100 = % slope

2. Measure the height of each ramp using the  tool. Be as exact as possible. Select **Analyze/Measure** and write the results in the table below. All measurements will be in pixels. (computer dots)

3. Swing the top "handle" of the line around to measure the length of the ramp. Again, select **Analyze/Measure** and record your results.

4. Close this picture and open up the next ramp. Repeat steps 2 and 3 until all ramps are measured.

5. Calculate the percent for each image and record it in the table.

	rise	**run**	**% slope**
Ramp 01			
Ramp 02			
Ramp 03			
Ramp 04			
Ramp 05			
Ramp 06			
Ramp 07			
Ramp 08			
Ramp 09			
Ramp 10			

6. Are any of the ramps too steep according to the law? If so, which ones?

Original Content Source

Foster, Winters, Gordon, Rath, Collins, Cuevas, Moore-Harris, & Swart (1998). Algebra I. New York: Glencoe.