M^2=Math Mediator Lesson 10: Slope

*__Materials needed for this lesson: see Activity in 3rd row.__

Total Recall (Warm-up) (5 minutes approx.)	Total Recall: Exercise from yesterday's lesson on area and Equations. 1. Find $h(x) = x^3 + 2$ for $x = 3$. A: $h(x) = 29$ 2. Graph $y = 3x - 2$ Use a table to find points. (A: y-intercept is -2, slope = 3)
Direct Instruction (5 minutes approx.)	Last lesson was about linear functions with form of $y = mx + b$ or $f(x) = mx + b$. The first being x-y notation, the second being functional notation. Then we graphed some functions and expressions. When you graph a line, notice how the pitch is different from other lines. It may be flat, with zero slope, or it may be vertical, with infinite slope, or it may be in between. Slope of a line is how the line tilts. Less slope means the line is closer to being horizontal or flat. More slope means that the line is closer to being vertical or up and down. Besides lines on a plot, what can you think of that has slope? A: Some possible answers are roads, roofs, ski slopes, skate board ramps, and plumbing in a house).
Activity (15 minutes approx.)	Divide the class into small groups. Hand out examples of slopes or have the students build their own slopes out of cardboard pieces or wood. Ask them to show the following from their sloped objects: 1. Less slope; 2. More slope; 3. Zero slope; 4. Infinite slope Each group builds a slope that has a height and a length, this is actually a right triangle. Write out the definition of slope: $slope = \frac{change\_in\_height}{change\_in\_length} = \frac{\Delta y}{\Delta x} = \frac{rise}{run}$ and for example, if a certain slope has a height of 3" and a length of 4"; the slope is ¾ or 0.75 or 75% slope. Have you ever noticed a road sign warning of a large slope or downhill ahead? These are typically at 8% or there about. Students will now use rulers to measure and calculate the slope of the items that they have built or were given. Next: have students graph lines that have the following slopes: 2, -2 and 6. Do do this, have the students pick a point on some graph paper or on a graph created on the whiteboard, and then count off the rise over run to plot a second point. Join the two points together to make a line. Next: have the students write equations for any lines that have the following slopes; zero slope and infinite slope. A: $y = 4$ and $x = 1$.
Direct Instruction and Practice (15 minutes approx.)	A study in London indicated that women who wore high heel shoes with a maximum of 15° slope with respect to the ground, developed stronger abdominal muscles. Over 15° created problems when shoes were worn for extended periods and repeatedly. Usually, shoes are not sold by degrees of heel slope, but by inches of heel height. So, just like the triangular slopes we analyzed earlier, we can apply the rise over run to a shoe and calculate the slope. First, we need to know what the length of a foot is per shoe size. Here is a list of common sizes:

	Women's shoe size Length of foot Ball of foot to heel (where slope starts) 3 8" 6" 6 9" 6.75" 9 10" 7.5" 12 11" 8.3" The ball of foot to heel distance is base on it being ¾ the total foot length. Slope = (heel height)/(ball to heel length) = 15° and to convert degrees to % slope we need to use something we will learn later in the year: tangent. The tangent of an angle (in degrees) equals the opposite side over the adjacent side, which in our case is the slope. Tangent can be found on the calculator by entering the number of degrees, 15, and making sure your calculator is in degrees mode, press the TAN button. So we have tan 15° = 0.27 or 27% slope is what we are interested in. So far, we have some lengths of our slope and our slope value. We still need heel heights. This can be calculated how? A: Heel height = .27(length) For shoe size 3: heel height = .27(6") = 1.62" *Have students create these For shoe size 6: heel height = .27(6.75) = 1.8" values. For shoe size 9: heel height = .27(7.5) = 2.1" For shoe size 6: heel height = .27(6.75) = 2.24" Notice that the range of heel heights is right around 2", so this is a good height to remember. Wearing shoes with higher heels for extended periods and repeatedly can lead to medical conditions called: hammertoes, bunions, corns and calluses, distorted Achilles heel and damaged toenails.
Direct Instruction; practice and assessment: (10 minutes approx.)	U-DO: 1. For a road with 8% slope, how much of an elevation change must occur for 100 feet of length? A: .08(100) = 8 feet 2. Given the points (3,4) and (0,0) and a line going through them, what is the slope of that line? A: $(y_2-y_1)/(x_2-x_1)$ 3. How about the slope of a line through (7,4) and (1,2)? 4. What is the slope of a line through (-3,2) and (2,-3)? 5. Graph 2 lines parallel to each other. What are each of their slopes? Suggestion, plot these lines through easy to work with points (2,2) and (4,3). A: parallel line have equal slope.
Exercise: (5 minutes approx.)	Perpendicular lines have slopes that are <u>negative reciprocals</u> of each other. 1. Line #1 is through points (1,1) and (3,2); which has what slope? A: ½ 2. What is the negative reciprocal of ½? A: -2 3. Graph the perpendicular line on the same graph as Line #1, from point (3,2).
Wrap-up	Wrap up closing comments and housekeeping. Suggest assigning 5 to 7

and homework assignment (5 minutes approx.)	homework problems on lines (e.g. Given two points that define a line, is another line, defined by two other points, parallel, perpendicular or neither?).