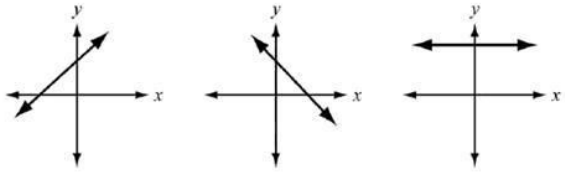
Richmond Public Schools

Curriculum Framework

Grade 8

Strand: Patterns, Functions, and Algebra	
8.16 The student will a) recognize and describe the graph of a linear function with a slope that is positive, negative, or zero; b) identify the slope and y-intercept of a linear function given a table of values, a graph, or an equation in y = mx + b form; c) determine the independent and dependent variable, given a practical situation modeled by a linear function; d) graph a linear function given the equation in y = mx + b form; and e) make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.	
Suggested Pacing	
First Nine Weeks – 8 Instructional Days (including common assessment)	
Related Standards	
Spiral Down **7.10** The student will a) determine the slope, *m*, as rate of change in a proportional relationship between two quantities and write an equation in the form $y = mx$ to represent the relationship; b) graph a line representing a proportional relationship between two quantities given the slope and an ordered pair, or given the equation in $y = mx$ form where m represents the slope as rate of change; c) determine the *y*-intercept, *b*, in an additive relationship between two quantities and write an equation in the form $y = x + b$ to represent the relationship; d) graph a line representing an additive relationship between two quantities given the *y*-intercept and an ordered pair, or given the equation in the form $y = x + b$, where *b* represents the *y*-intercept; and	**Spiral Up** **A.6** The student will a) determine the slope of a line when given an equation of the line, the graph of the line, or two points on the line; b) write the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line; and c) graph linear equations in two variables. **A.7** The student will investigate and analyze linear and quadratic functions families and their characteristics both algebraically and graphically, including a) determining whether a relation is a function; b) domain and range; c) zeros; d) intercepts; e) values of a function for elements in its domain; and

e) make connections between and among representations of a proportional or additive relationship between two quantities using verbal descriptions, tables, equations, and graphs. 6.12 The student will a) represent a proportional relationship between two quantities, including those arising from practical situations; b) determine the unit rate of a proportional relationship and use it to find a missing value in a ratio table; c) determine whether a proportional relationship exists between two quantities; and d) make connections between and among representations of a proportional relationship between two quantities using verbal descriptions, ratio tables, and graphs.	f) connections between and among multiple representations of functions using verbal descriptions, tables, equations, and graphs.
Essential Questions	**Common Misconceptions**
What is the relationship between an equation, function table, and ordered pairs. *Any given relationship can be represented by all four.* **What is a positive, negative, and zero slope?** *A positive slope is a line that rises or increases from left to right. The rate of change is positive. A negative slope is a line that falls or decreases from left to right. The rate of change is negative. A zero slope is a horizontal line that is constant from left to right. The rate of change is zero.*	• Students have trouble remembering how to graph a function when given an equation. • Students need to be reminded to check all values from function table to check validity. • Students need additional practice identifying the graph represented by a linear equation. • Students frequently select a graph with the correct y-intercept without further investigating other points on the line. • Students need additional practice determining the domain or range when given an equation and an identified set of values. • Students need additional practice identifying the dependent and independent variable when given a practical problem. (VDOE – Spring 2014 Student Performance Analysis comment)

	• Students need additional practice translating a word problem into an algebraic equation. (VDOE - Spring 2012 Student Performance Analysis comment)
Understanding the Standard	**Essential Knowledge and Skills**
• A linear function is an equation in two variables whose graph is a straight line, a type of continuous function. • A linear function represents a situation with a constant rate. For example, when driving at a rate of 35 mph, the distance increases as the time increases, but the rate of speed remains the same. • Slope (m) represents the rate of change in a linear function or the "steepness" of the line. The slope of a line is a rate of change, a ratio describing the vertical change to the horizontal change. $$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{\text{vertical change}}{\text{horizontal change}}$$ • A line is increasing if it rises from left to right. The slope is positive (i.e., $m > 0$). • A line is decreasing if it falls from left to right. The slope is negative (i.e., $m < 0$). • A horizontal line has zero slope (i.e., $m = 0$).  A line with a ***positive slope*** slants up to the right. A line with a ***negative slope*** slants down to the right. A line with a ***slope of 0*** is horizontal.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize and describe a line with a slope that is positive, negative, or zero (0). (a) • Given a table of values for a linear function, identify the slope and y-intercept. The table will include the coordinate of the y-intercept. (b) • Given a linear function in the form $y = mx + b$, identify the slope and y-intercept. (b) • Given the graph of a linear function, identify the slope and y-intercept. The value of the y-intercept will be limited to integers. The coordinates of the ordered pairs shown in the graph will be limited to integers. (b) • Identify the dependent and independent variable, given a practical situation modeled by a linear function. (c) • Given the equation of a linear function in the form $y = mx + b$, graph the function. The value of the y-intercept will be limited to integers. (d) • Write the equation of a linear function in the form $y = mx + b$ given values for the slope, m, and the y-intercept or given a practical situation in which the slope, m, and y-intercept are described verbally.(e)

- A discussion about lines with undefined slope (vertical lines) should occur with students in grade eight mathematics to compare undefined slope to lines with a defined slope. Further exploration of this concept will occur in Algebra I.
- A linear function can be written in the form $y = mx + b$, where m represents the slope or rate of change in y compared to x, and b represents the y-intercept of the graph of the linear function. The y-intercept is the point at which the graph of the function intersects the y-axis and may be given as a single value, b, or as the location of a point $(0, b)$.
  - Example: Given the equation of the linear function $y = -3x + 2$, the slope is -3 or $\frac{-3}{1}$ and the y-intercept is 2 or (0, 2).
  - Example: The table of values represents a linear function.

In the table, the point (0, 2) represents the y-intercept. The slope is determined by observing the change in each y-value compared to the corresponding change in the x-value.

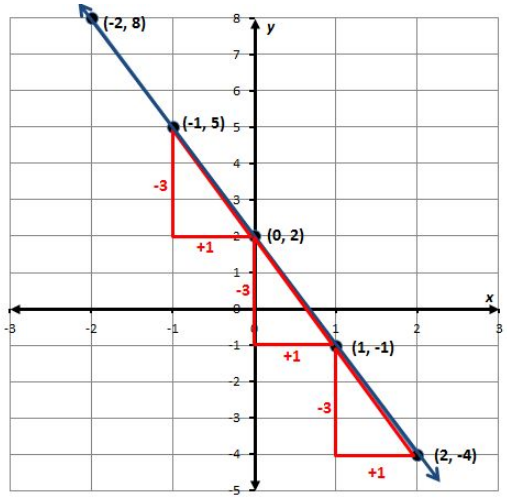
	x	y	
+1	-2	8	-3
+1	-1	5	-3
+1	0	2	-3
+1	1	-1	-3
+1	2	-4	

slope = $m = \frac{change\ in\ y\text{-}value}{change\ in\ x\text{-}value} = \frac{-3}{+1} = -3$

- The slope, m, and y-intercept of a linear function can be determined given the graph of the function.

- Make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs. (e).

- Example: Given the graph of the linear function, determine the slope and *y*-intercept.



Given the graph of a linear function, the *y*-intercept is found by determining where the line intersects the *y*-axis. The *y*-intercept would be 2 or located at the point (0, 2). The slope can be found by determining the change in each *y*-value compared to the change in each *x*-value. Here, we could use slope triangles to help visualize this:

$$\text{slope} = m = \frac{\textit{change in y-value}}{\textit{change in x-value}} = \frac{-3}{+1} = -3$$

- Graphing a linear function given an equation can be addressed using different methods. One method involves determining a table of ordered pairs by substituting into the equation values for one variable and solving for the other variable, plotting the ordered pairs in the coordinate plane, and connecting the points to form a straight line. Another method involves using slope triangles to determine points on the line.

- Example: Graph the linear function whose equation is

  $y = 5x - 1$.

In order to graph the linear function, we can create a table of values by substituting arbitrary values for x to determining coordinating values for y:

x	$5x - 1$	y
-1	5(-1) - 1	-6
0	5(0) - 1	-1
1	5(1) - 1	4
2	5(2) - 1	9

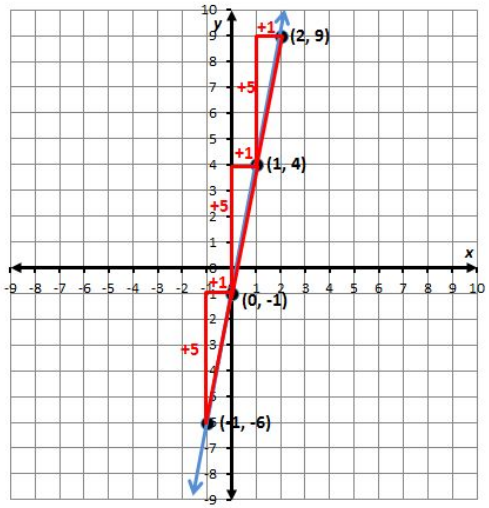
The values can then be plotted as points on a graph.

Knowing the equation of a linear function written in $y = mx + b$ provides information about the slope and y-intercept of the function. If the equation is $y = 5x - 1$, then the slope, m, of the line is 5 or $\frac{5}{1}$ and the y-intercept is -1 and can be located at the point $(0, -1)$. We can graph the line by first plotting the y-intercept. We also know,

slope = $m = \frac{change\ in\ y\text{-}value}{change\ in\ x\text{-}value} = \frac{+5}{+1}$

Other points can be plotted on the graph using the relationship between the y and x values.

Slope triangles can be used to help locate the other points as shown in the graph below:



- A table of values can be used in conjunction with using slope triangles to verify the graph of a linear function. The *y*-intercept is located on the *y*-axis which is where the *x*-coordinate is 0. The change in each *y*-value compared to the corresponding *x*-value can be verified by the patterns in the table of values.

x	*y*	
-1	-6	
		+5
+1		
0	-1	
		+5
+1		
1	4	
		+5
+1		
2	9	

- The axes of a coordinate plane are generally labeled *x* and *y*; however, any letters may be used that are appropriate for the function.

- A function has values that represent the input (x) and values that represent the output (y). The independent variable is the input value.
- The dependent variable depends on the independent variable and is the output value.
- Below is a table of values for finding the approximate circumference of circles, $C = \pi d$, where the value of π is approximated as 3.14.

Diameter	Circumference
1 in.	3.14 in.
2 in.	6.28 in.
3 in.	9.42 in.
4 in.	12.56 in.

  - The independent variable, or input, is the diameter of the circle. The values for the diameter make up the domain.
  - The dependent variable, or output, is the circumference of the circle. The set of values for the circumference makes up the range.
- In a graph of a continuous function every point in the domain can be interpreted. Therefore, it is possible to connect the points on the graph with a continuous line because every point on the line answers the original question being asked.
- The context of a problem may determine whether it is appropriate for ordered pairs representing a linear relationship to be connected by a straight line. If the independent variable (x) represents a discrete quantity (e.g., number of people, number of tickets, etc.) then it is not appropriate to connect the ordered pairs with a straight line when graphing. If the independent

variable (x) represents a continuous quantity (e.g., amount of time, temperature, etc.), then it is appropriate to connect the ordered pairs with a straight line when graphing.

- Example: The function $y = 7x$ represents the cost in dollars (y) for x tickets to an event. The domain of this function would be discrete and would be represented by discrete points on a graph. Not all values for x could be represented and connecting the points would not be appropriate.
- Example: The function $y = -2.5x + 20$ represents the number of gallons of water (y) remaining in a 20-gallon tank being drained for x number of minutes. The domain in this function would be continuous. There would be an x-value representing any point in time until the tank is drained so connecting the points to form a straight line would be appropriate (Note: the context of the problem limits the values that x can represent to positive values, since time cannot be negative.).

- Functions can be represented as ordered pairs, tables, graphs, equations, physical models, or in words. Any given relationship can be represented using multiple representations.
- The equation $y = mx + b$ defines a linear function whose graph (solution) is a straight line. The equation of a linear function can be determined given the slope, m, and the y-intercept, b. Verbal descriptions of practical situations that can be modeled by a linear function can also be represented using an equation.
  - Example: Write the equation of a linear function whose slope is $\frac{3}{4}$ and y-intercept is -4, or located at the point $(0, -4)$.

The equation of this line can be found by substituting the values for the slope, $m = \frac{3}{4}$, and the y-intercept, $b = -4$, into the general form of a linear function $y = mx + b$. Thus, the equation would be $y = \frac{3}{4}x - 4$.

- Example: John charges a $30 flat fee to troubleshoot a personal watercraft that is not working properly and $50 per hour needed for any repairs. Write a linear function that represents the total cost, y of a personal watercraft repair, based on the number of hours, x, needed to repair it. Assume that there is no additional charge for parts.

In this practical situation, the y-intercept, b, would be $30, to represent the initial flat fee to troubleshoot the watercraft. The slope, m, would be $50, since that would represent the rate per hour. The equation to represent this situation would be $y = 50x + 30$.

- A proportional relationship between two variables can be represented by a linear function $y = mx$ that passes through the point (0, 0) and thus has a y-intercept of 0. The variable y results from x being multiplied by m, the rate of change or slope.
- The linear function $y = x + b$ represents a linear function that is a non-proportional additive relationship. The variable y results from the value b being added to x. In this linear relationship, there is a y-intercept of b, and the constant rate of change or slope would be 1. In a linear function with a slope other than 1, there is a coefficient in front of the x term, which represents the constant rate of change, or slope.
- Proportional relationships and additive relationships between two quantities are special cases of linear functions that are discussed in grade seven mathematics.

Richmond Public Schools

Curriculum Framework

Grade 8

Vocabulary	Instructional Activities Organized by Learning Objective
Linear Function Continuous Function Constant Rate Slope Vertical Change Horizontal Change Positive Slope Negative Slope Zero Slope Undefined Slope Slope Triangles Slope-Intercept Form (y=mx+b) *y*-intercept Input Output Independent Variable Dependent Variable Domain Range Function Table Ordered Pair Proportional Relationship	**Virginia Department of Education** **Textbook** *Virginia Pre-Algebra, ©2012, Glencoe/McGraw-Hill* ● Ordered Pairs and Relations, page(s) 25 – 30 ● Word, Equations, Tables, and Graphs, page(s) 33 – 37 ● Functions, page(s) 399 – 404 **(in part)** ● Representing Linear Functions, page(s) 410 – 415 ● Slope, page(s) 433 – 437 ● Slope-Intercept Form, page(s) 439 - 444 **(in part)** ● Writing Linear Equations, page(s) 447 - 453 **(in part)** **Notes** **Resources** ● **Print** *Virginia Coach,* NEW SOL Edition, Grade 8, Mathematics Lesson 19 – page 143 (Relations and Functions)**(in part)** Lesson 20 – page 151 (Describe Functions)**(in part)** Lesson 21 – page 157 (Represent Functions) ● **Technology-based** o *Exchange.Smarttech.com (SMART Board)* – Slope – SMART Notebook Lesson **SMART Board required* o *ExploreLearning.com (Gizmo)* – Introduction to Functions – Interactive Instructional Resource **Sign-in required* **Station Activities** ● Slope Task Cards - Have students complete problems in small groups; Think-Pair-Share
Assessment	
RPS PowerSchool Unit Test – RPS 8.16 Common Assessment Test ID #: **Formative Assessments** White Board Checks Kahoot.it	

Plickers Exit Tickets Graphic Organizers Venn Diagrams	• Slope-Intercept Graphic Organizer - Have students create a foldable, describing characteristics, providing examples, and relationships. • I have … Who has - Hand students a card with either a ordered pair or a slope, have students work in pairs to find their match. • Independent/Dependent Variable Sort - Have students sort practical problems based on independent and dependent variables. • Linear Relations Scavenger Hunt
Cross-Curricular Connections	**Differentiations**
Science Give examples of science fair projects the students may have done. Have them identify the IV and DV of the given situations. **English** Have students explain the differences between domain, range, IV and DV. **History** Discuss the causes and effects of a war.	• Give students graphing paper and have them draw a linear line and give at least three points on the line. • From above, have students choose two points and find the slope. • Have students find the slope of other lines from their classmates. • Have students discuss how a positive and negative slope are similar and different.