Richmond Public Schools

Curriculum Framework

7^{th} Grade Math

Strand: Patterns, Functions, and Algebra	
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 $y = mx + b$, where *b* represents the *y*-intercept; and make connections between and among representations of a proportional or additive relationship between two quantities using verbal descriptions, tables, equations, and graphs.**	
Suggested Pacing	
Third Nine Weeks – 8 days	
Spiraling Standards	
Spiraling Down: **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	Spiraling Up: **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

d) make connections between and among representations of a proportional relationship between two quantities using verbal descriptions, ratio tables, and graphs **5.18** The student will identify, describe, create, express, and extend number patterns found in objects, pictures, numbers and tables.	e) make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.
Essential Questions	**Common Misconceptions**
Understanding the Standard	**Essential Knowledge and Skills**
● When two quantities, x and y, vary in such a way that one of them is a constant multiple of the other, the two quantities are "proportional". A model for that situation is $y = mx$ where m is the slope or rate of change. Slope may also represent the unit rate of a proportional relationship between two quantities, also referred to as the constant of proportionality or the constant ratio of y to x. ● The slope of a proportional relationship can be determined by finding the unit rate. Example: The ordered pairs (4, 2) and (6, 3) make up points that could be included on the graph of a proportional relationship. Determine the slope, or rate of change, of a line passing through these points. Write an equation of the line representing this proportional relationship.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** ● Determine the slope, m, as rate of change in a proportional relationship between two quantities given a table of values or a verbal description, including those represented in a practical situation, and write an equation in the form $y = mx$ to represent the relationship. Slope will be limited to positive values. (a) ● Graph a line representing a proportional relationship, between two quantities given an ordered pair on the line and the slope, m, as rate of change. Slope will be limited to positive values. (b) ● Graph a line representing a proportional relationship between two quantities given the equation of the line in the form $y = mx$, where m represents the slope as rate of change. Slope will be limited to positive values. (b) ● Determine the y-intercept, b, in an additive relationship between two quantities given a table of values or a verbal description, including

x	y
4	2
6	3

The slope, or rate of change, would be $\frac{1}{2}$ or 0.5 since the y-coordinate of each ordered pair would result by multiplying $\frac{1}{2}$ times the x-coordinate. This would also be the unit rate of this proportional relationship. The ratio of y to x is the same for each ordered pair. That is, $\frac{y}{x} = \frac{2}{4} = \frac{3}{6} = \frac{1}{2} = 0.5$

The equation of a line representing this proportional relationship of y to x is $y = \frac{1}{2}x$ or $y = 0.5x$.

- The slope of a line is a rate of change, a ratio describing the vertical change to the horizontal change of the line.

$$\text{slope} = \frac{\textit{change in y}}{\textit{change in x}} = \frac{\textit{vertical change}}{\textit{horizontal change}}$$

- The graph of the line representing a proportional relationship will include the origin (0, 0).
- A proportional relationship between two quantities can be modeled given a practical situation. Representations may include verbal descriptions, tables, equations, or graphs. Students may benefit from an informal discussion about independent and dependent variables when modeling practical situations. Grade eight mathematics formally addresses identifying dependent and independent variables.
    - o Example (using a table of values): Cecil walks 2 meters every second (verbal description). If x

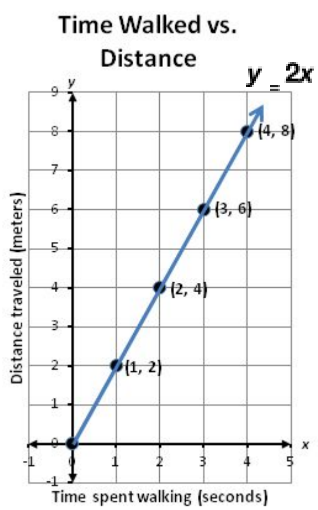
those represented in a practical situation, and write an equation in the form $y = x + b$, $b \neq 0$, to represent the relationship. (c)

- Graph a line representing an additive relationship ($y = x + b$, $b \neq 0$) between two quantities, given an ordered pair on the line and the y-intercept (b). The y-intercept (b) is limited to integer values and slope is limited to 1. (d)
- Graph a line representing an additive relationship between two quantities, given the equation in the form $y = x + b$, $b \neq 0$. The y-intercept (b) is limited to integer values and slope is limited to 1. (d)
- Make connections between and among representations of a proportional or additive relationship between two quantities using verbal descriptions, tables, equations, and graphs. (e)

represents the number of seconds and y represents the number of meters he walks, this proportional relationship can be represented using a table of values:

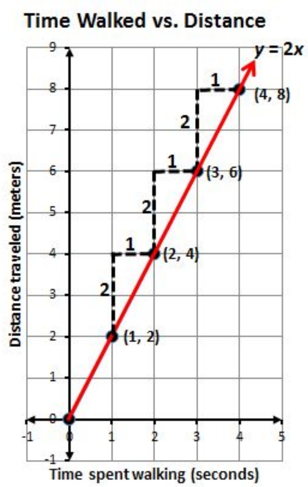
x (seconds)	1	2	3	4
y (meters)	2	4	6	8

This proportional relationship could be represented using the equation $y = 2x$, since he walks 2 meters for each second of time.That is, $\frac{y}{x} = \frac{2}{1} = \frac{4}{2} = \frac{6}{3} = \frac{8}{4} = 2$, the unit rate (constant of proportionality) is 2 or $\frac{2}{1}$. The same constant ratio of y to x exists for every ordered pair. This proportional relationship could be represented by the following graph:



- A graph of a proportional relationship can be created by graphing ordered pairs generated in a table of values (as shown above), or by observing the rate of change or slope of the relationship and using slope triangles to graph ordered pairs that satisfy the relationship given.

- Example (using slope triangles): Cecil walks 2 meters every second. If x represents the number of seconds and y represents the number of meters he walks, this proportional relationship can be represented graphically using slope triangles.



The rate of change from (1, 2) to (2, 4) is 2 units up (the change in y) and 1 unit to the right (the change in x), $\frac{2}{1}$ or 2. Thus, the slope of this line is 2. Slope triangles can be used to generate points on a graph that satisfy this relationship.

- Proportional thinking requires students to thinking multiplicatively. However, the relationship between two quantities is not always proportional. The relationship between two quantities could be additive (i.e., one quantity is a result of adding a value to the other quantity) or multiplicative (i.e.., one quantity is the result of multiplying the other quantity by a value). Therefore, it is important to use practical situations to model proportional relationships, since context can help students to see the relationship.
  - Example:

Additive relationship:

x		y
2	$\xrightarrow{+8}$	10
3	$\xrightarrow{+8}$	11
4	$\xrightarrow{+8}$	12
5	$\xrightarrow{+8}$	13

Multiplicative relationship:

x		y
2	$\xrightarrow{\cdot 5}$	10
3	$\xrightarrow{\cdot 5}$	15
4	$\xrightarrow{\cdot 5}$	20
5	$\xrightarrow{\cdot 5}$	25

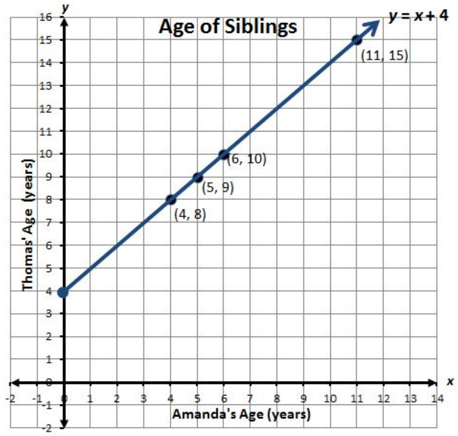
In the additive relationship, y is the result of adding 8 to x.
In the multiplicative relationship, y is the result of multiplying 5 times x.

The ordered pair (2, 10) is a quantity in both relationships, however, the relationship evident between the other quantities in the table, discerns between additive or multiplicative.

- Two quantities, x and y, have an additive relationship when a constant value, b, exists where $y = x + b$, where $b \neq 0$. An additive relationship is not proportional and its graph does not pass through (0, 0). Note that b can be a positive value or a negative value. When b is negative, the right side of the equation could be written using a subtraction symbol (e.g., if b is −5, then the equation $y = x - 5$ could be used).
  - Example: Thomas is four years older than his sister, Amanda (verbal description). The following table shows the relationship between their ages at given points in time.

Amanda's Age	4	5	6	11
Thomas' Age	8 (+4)	9 (+4)	10 (+4)	15 (+4)

The equation that represents the relationship between Thomas' age and Amanda's age is $y = x + 4$. A graph of the relationship between their ages is shown below:



- Graphing a line 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 equation $y = x - 1$. In order to graph the equation, we can create a table of values by substituting arbitrary values for x to determine coordinating values for y:

x	x - 1	y
-1	(-1) - 1	-2
0	(0) - 1	-1
1	(1) - 1	0
2	(2) - 1	1

These values can then be plotted as the points (-1, -2), (0, -1), (1, 0), and (2, 1) on a graph.

An equation written in $y = x + b$ form provides information about the graph. If the equation is $y = x - 1$, then the slope, m, of the line is 1 or $\frac{1}{1}$ and the point where the line crosses the y-axis can be located at (0, -1). We also know,

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

So we can plot some other points on the graph using this relationship between y and x values.

A table of values can be used to determine the graph of a line. 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	-2	
+1	0	-1	+1
+1	1	0	+1
+1	2	1	+1

Vocabulary	Instructional Activities Organized by Learning Objective

Vocabulary

Rate
Rate of Change
Slope
Vertical
Horizontal
Graph
Y-Intercept
Linear Equation
Proportional Relationship
Constant Ratio
Ordered Pair
Table

Instructional Activities Organized by Learning Objective

Virginia Department of Education
N/A

Textbook
Virginia Math Connects, Course 2, ©2012, Price, et al, McGraw-Hill School Education Group 1, pgs 391-400

Notes
Guided Notes- Slope and Intercept

Resources
- Print

Verbal Equation
Slope Triangles
	Histogram Foldable
	● Technology-based
	  o Brain Pop
	    ▪ Slope and Intercept
	
	Station Activities
	Frequency Table to Histograms
	Histograms and Other Graphical Methods
	Statistical Practice Questions
	Matching Histograms

Assessment	
Cross-Curricular Connections	**Tiered Differentiations**
Soil Science- Students can investigate the natural slopes of a variety of differing rocks and soils and how they can be used for construction. (STEM Assignment Teaching Engineering)	(Tier One) Students are given a slope and must come up with a linear equation that runs through that given equation and at which coordinate? (Tier Two) Students are to interpret a given slope intercept form and determines what happens to the equation at different x-coordinates and then finally predicting what the y-coordinate would be at greater x values. (Tier Three) Students must determine whether the slopes are positive or negative and where they equation crosses the y or x axis.