Program Information								
	[Lesson Title]				**TEACHER NAME** **Julie Thumann**		**PROGRAM NAME** **Cincinnati City Schools**	
	[Unit Title] ***Linear Functions Interactive Notebook***				**NRS EFL(s)** **3 – 6**		**TIME FRAME** **4 – 7 classes (75 minutes each)**	
Instruction	**OBR ABE/ASE Standards – Mathematics**							
	Numbers (N)		**Algebra (A)**		**Geometry (G)**		**Data (D)**	
	Numbers and Operation		Operations and Algebraic Thinking		Geometric Shapes and Figures		Measurement and Data	
	The Number System	**N.4.1**	Expressions and Equations	**A.4.9** **A.4.10** **A.5.6** **A.5.9**	Congruence		Statistics and Probability	
	Ratios and Proportional Relationships	**N.3.32**	Functions	**A.4.12** **A.4.13** **A.4.14** **A.4.15** **A.5.11** **A.5.13** **A.6.7**	Similarity, Right Triangles. And Trigonometry		**Benchmarks identified in red are priority benchmarks. Please see the Curriculum Alignments available on the Teacher Resource Center for a complete list of priority benchmarks and related Ohio ABLE lesson plans.*	
	Number and Quantity				Geometric Measurement and Dimensions			

		Modeling with Geometry		

Mathematical Practices (MP)			
✓	Make sense of problems and persevere in solving them. (MP.1)	✓	Use appropriate tools strategically. (MP.5)
✓	Reason abstractly and quantitatively. (MP.2)	☐	Attend to precision. (MP.6)
✓	Construct viable arguments and critique the reasoning of others. (MP.3)	☐	Look for and make use of structure. (MP.7)
✓	Model with mathematics. (MP.4)	✓	Look for and express regularity in repeated reasoning. (MP.8)

LEARNER OUTCOME(S)

Students will be able to:

- Determine the slope of a line from a graph, equation, or table
- Interpret unit rate as the slope in a proportional relationship of real-world and mathematical problems
- Complete a table of x-and y-values for a linear equation
- Use x-and y-values to graph a linear equation
- Graph linear equations to solve real-world problems

ASSESSMENT TOOLS/METHODS

- Student responses to teacher questions during class discussions
- Checks for understanding
- Teacher observation of student work
- Student answers to in-class assignments
- Assessment #1 (Vocabulary Review, Skill Review, Skill Practice) from Common Core Achieve: Mastering Essential Test Readiness Skills (Mathematics) pgs. 156 – 157
- Assessment #2 (Vocabulary Review, Skill Review, Skill Practice) from Common Core Achieve: Mastering Essential Test Readiness Skills (Mathematics) pgs. 164 – 165
- Assessment #3 (Vocabulary Review, Skill Review, Skill Practice) from Common Core Achieve: Mastering Essential Test Readiness Skills (Mathematics) pgs. 170 - 171

LEARNER PRIOR KNOWLEDGE

- Knowledge of fractions, integers, number lines, and coordinate plane
- Evaluate an expression (plug-in given numbers to solve for the unknown variable)

- This lesson begins with a review of prior knowledge; referencing integers and coordinate plane

INSTRUCTIONAL ACTIVITIES	RESOURCES
1. Pass out *Integers Foldable Layered-Look Book* handout. a. Model folding instructions and provide supplies for students to create the foldable. b. Complete the *Integers Foldable Layered-Look Book* as a class. i. Model how to solve example problems. ii. Collaborate for writing the rule summary on the bottom of each page. iii. Glue or staple the completed *Integers Foldable Layered-Look Book* into your notebook. 2. *Interpret Slope and Linear Functions* a. Introduction: i. Slope, a measure of the steepness of a line, is the ratio of vertical change to horizontal change (or rise over run). ii. We are able to measure slope on a coordinate plane. iii. Let's discuss a real-life example of a coordinate plane – city streets. In many cities, streets that run east and west are named with numbers, and streets that run north and south are named with letters. Due to this convenient naming system, it is easy for people to navigate in an unfamiliar city and find their locations. iv. Let's take a look at a coordinate plane. b. Pass out *Graphing Ordered Pairs* handout. i. Label as a class. Discuss how grid is similar to the city street example – the east and west is the horizontal x-axis, and the north and south is the vertical y-axis. Ask the class if they have seen this grid in other real-life situations? ii. Glue or staple *Graphing Ordered Pairs* handout into your	Notebooks or folders for student use Student copies of *Integers Foldable Layered-Look Book* handout (attached) Stapler for student use Glue sticks for student use Projector/ability to project Chalkboard or whiteboard Student copies of *Graphing Ordered Pairs* (attached, 2 handouts per page) Student copies of *Interpreting Slope From a Graph or Table* booklet (attached) Assessment-on-a-stick for student use (attached) Student copies of *Linear Relationships* graphic organizer (attached) West Virginia Board of Education: Frayer Model. (n.d.). Retrieved from https://wvde.state.wv.us/strategybank/FrayerModel.html

	notebook. c. Now, add the lesson's vocabulary words and definitions in your notebook: i. Coordinate plane – a grid formed by the intersection of a horizontal number line and a vertical number line ii. Quadrant – 1 of the 4 regions of the coordinate plane formed by the intersection of the x and y axis iii. Ordered pairs – a pair of numbers (x,y) that is used to describe the location of a point on a coordinate grid iv. Slope – the ratio of vertical change to horizontal change v. Unit rate – a rate that compares to one unit, such as mile per gallon *d.* Next, we will begin a new page in the notebook titled *Interpreting Slope From a Graph or Table* *3.* *Interpreting Slope From a Graph or Table* handout *a.* Pass out *Interpreting Slope From a Graph or Table* handout. Model folding instructions and provide supplies for students to create the foldable. *i.* This handout will need to be folded vertically and then accordion-style. ii. Glue or staple *Interpreting Slope From a Graph or Table* handout into your notebook b. Add the definition for slope to your notebook: i. Slope should always be reported in the proper units: Dependent variable units (y-axis) Independent variable units (x-axis) ii. The slope of the line represents the ratio of change in the dependent variable/y-axis/rise to the change in the independent variable/x-axis/run. c. Whole class discussion and completion of *Slope From a Graph or Table* handout. i. Write on the board, "We will now be able to answer the	Student copies of *Math Talk Bookmark* (attached) Student copies of Math Talk Bookmark (attached) Math Talk Bookmark. (n.d.). Retrieved from https://www.pinterest.com/pin/30751209929886153/ Student copies of *Linear or Nonlinear Card Sort* (attached) Student copies of *All Linear Patterns* handout (attached, 2 per page) Using the Think-Pair-Share Technique-ReadWriteThink. (n.d.). Retrieved from http://www.readwritethink.org/professional-development/strategy-guides/using-think-pair-share-30626.html Student copies of *Slope and Intercept Practice* foldable (attached) Student copies of *X-Intercept* (attached) Student copies of *Y-intercept* (attached) Student copies of the *Linear Equations Flippables* (attached) *Common core achieve: Mastering essential test readiness skills* (Mathematics). (2015). Columbus, OH: McGraw-Hill Education.

	question how do you calculate the rate of change on a linear model?" The model today is a table or graph. Refer to the completed *Slope From a Graph or Table* handout for class examples. i. Model the first example, *Paul's Job.* Check student understanding using the Happy/Sad Face Assessment-on-a-Stick or Thumbs Up/Thumbs Down. ii. Have students complete the remaining examples (*Oil in the Oil Tank*, *Todd's Account*, *Delivery Service Charges*, *Donna's Yard Service*) and review answers as a class. *4. Analyze Linear and Nonlinear Relationships* a. Pass out the *Linear Relationships* graphic organizer to define linear. i. Explanation of a linear relationship will be defined and completed together – write the template on the board or project the template on a whiteboard. i. As you complete the graphic organizer with the class, ask students to also explain nonlinear (use phrases from the *Math Talk Bookmark* to solicit student responses and check student understanding). b. *Linear or Nonlinear Card Sort* i. Pass out *Linear or Nonlinear Card Sort* envelopes. 1. Instruct students to make a t-chart in their notebooks. Label one side of the t-chart "Linear" and the other side of the t-chart "Nonlinear" 2. Each envelop should contain 4 graphs and 4 tables. Students are to identify each graph and table as linear or nonlinear and glue or tape the graph or table into the correct column in their notebook. 3. Walk around the room to observe student work and answer student questions (use phrases from the *Math Talk Bookmark* to solicit student responses and check student understanding). ii. Review correct answers.	Zike, D. (n.d.). *Teaching Mathematics with Foldables*. Retrieved from https://blogs.edutech.nodak.edu/badlandsreadingcouncil/files/2012/03/math-foldables.pdf

1. How do linear and nonlinear functions change the data?
2. Which function has a constant change in rate?
3. Why would data be important in real-life situations?
4. Which interpretation is easier to comprehend, the graph or table?

5. *All Linear Patterns* handout
   a. Pass out *All Linear Patterns* handout. Each student should receive four patterns to solve and continue the pattern.
   b. Model how to solve one of the patterns.
   c. For the remaining patterns, have students use Think-Ink-Pair-Share to complete. Remind students that f(x) means function. However, for the purpose of this lesson f(x) is like the y.r
      i. Students think about the problem.
      ii. Students write down their answers.
      iii. Students pair with a partner to discuss.
      iv. Students share with their partner and share out to the rest of the class the correct answer and how they solved the problem.
6. *Slope and Intercept Practice*
   a. To help graph and comprehend the equations students need to understand the importance of the x and y intercepts. Instruct your students to start a new page in their notebooks and title it *Slope and Intercept Practice*.
      i. Teacher will need to print out the following: *Slope and Intercept Practice* foldable*, X-Intercept*, *Y-intercept*.
      ii. Before class, cut-out the x and y intercept rectangles, and fold.
   a. Each student needs one x-intercept cut out and one y intercept cut out.
   b. Ask students to glue these under the title, *Slope and Intercept Practice*.

c. Refer to completed, *Slope and Intercept Practice foldable*.
d. Write these ordered pairs on the board: (-2,-2) and (1,4). Have students plot the points and then record the x-intercept and the y-intercept and the slope.
e. Follow the same procedure for the next ordered pairs: (-4,0) and (0,-1)
f. Discuss the difference between a positive and negative slope. The first example is a positive slope - the line rises from the left to the right and the second example has a negative slope – lines that fall from left to right.

7. *Write the Equation of a Line*
   a. The equation of a line can be written many different ways. You can use given information about the line to determine the best way to write the equation.
   b. A good example of this is a cell phone bill. Some cell phone companies charge an initial fee and then add additional changes for each byte of data used. To find the total cost of your monthly bill you use the same formula used to write the equation of a line. If you were to graph this information, your graph would be a line that describes the relationship between the data used and the total monthly cost of your cell phone.
   c. Today we will use two different formulas to write an equation.
      i. Pass out the *Linear Equations Flippables*.
      ii. Model folding instructions and provide supplies for students to create the foldable.
      iii. Present and explain examples for each formula. Then provide more examples on the board and remind students to write the examples in their notebooks. Students will use the *Linear Equations Flippables* for reference.
      iv. Examples for Slope-Intercept Form: y=mx+b
         1. Write the equation of the line with the slope of -5 and y-intercept of 4.
            a. Step 1: identify m= -5, b=4

	b. Step 2: use these values to write the equations: y=5x+4 2. A line has a slope of 3 and contains the points (2,7) a. Step 1: m=3, x=2, y=7 b. Step 2: solve to find the value of b. 7=3(2) + b 7=6 + b 1=b c. Therefore: y=3x + 1 v. Example for the Point – Slope Form: y-y=m(x-x) 1. A line has a slope of 1 and contains the point (4, -3) a. Step 1: Substitute the values: y-(-3)=1(x-4) b. Step 2: y+3=x-4 c. Step 3: Subtract 3 from both sides: y=x-7 vi. Example for Slope Formula: write an equation given two points 1. A line contains the points (4,-4) and (3,0) a. Step 1: Find the slope using the Slope Formula: m=-4-0=-4=-4 4-3=1 b. Step 2: Now that you know the slope you may use either formula to write the equation, and choose only one of the given points. Y=mx+b 0=-4(3)+b 0=-12+b 12=b c. Step 3: Plug in for m and b Y=-4x+12 8. Have students complete Assessment #1 (Vocabulary Review, Skill Review,	

	Skill Practice) from Common Core Achieve: Mastering Essential Test Readiness Skills (Mathematics) pgs. 156 – 157, Assessment #2 (Vocabulary Review, Skill Review, Skill Practice) from Common Core Achieve: Mastering Essential Test Readiness Skills (Mathematics) pgs. 164 – 165, Assessment #3 (Vocabulary Review, Skill Review, Skill Practice) from Common Core Achieve: Mastering Essential Test Readiness Skills (Mathematics) pgs. 170 – 171 in class or for homework. Students may use their Interactive Notebook for the assessments. 9. Once complete review and discuss the answers in class or collect the assessments to check and review with students individually.	
	DIFFERENTIATION • Provide students with partially complete handout, graphic organizer, and/or foldables • Display written vocabulary terms and definitions • Allow students to work individually, in pairs, or in class groups	
Reflection	**TEACHER REFLECTION/LESSON EVALUATION**	
	ADDITIONAL INFORMATION	

Integers

Adding Integers with the SAME SIGN

Example 1: $5 + 7 =$	Model:
Example 2: $-5 + (-7) =$	Model:

Multiplying & Dividing Integers with DIFFERENT SIGNS

Multiplying	Dividing
Example 13 : $-4(9) =$ Example 14: $8(-7) =$	Example 15: $-49 \div 7 =$ Example 16: $\frac{64}{-4} =$

Summary:

× Multiplying & Dividing ÷

Rule: To subtract an integer,

_____.

Example 5:

$12 - (-7) =$

Example 6:

$-9 - 4 =$

Example 7:

$-15 - (-3) =$

Example 8:

$7 - 10 =$

Summary:

– Subtracting –

Multiplying & Dividing Integers with the SAME SIGNS

Multiplying	Dividing
Example 9: $6(8) =$	Example 11: $24 \div 3 =$
Example 10: $-11(-9) =$	Example 12: $\frac{-20}{-4} =$

Adding Integers with DIFFERENT SIGNS

Example 3: $-5 + 7 =$	Model:
Example 4: $5 + (-7) =$	Model:

Summary:

+ Adding +

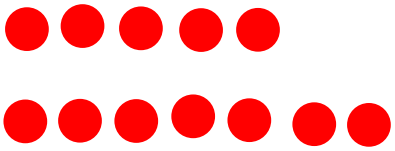
Below I have worked out all of the problems, written in the summary, and models for adding integers. Feel free to adapt it to your students. For example, in "modeling" I usually use integer chips in the beginning and use the number line later. You could always do that differently. Also, when it comes to the "summary", I have my students write this piece. I believe that section should be student generated so that it makes sense to them and will serve as a better study tool.

ENJOY! ☺

Integers

Adding Integers with the SAME SIGN

= positive
= negative

Example 1: $5 + 7 = 12$	Model: = positive 12
Example 2: $-5 + (-7) = -12$	Model:  = negative 12

Multiplying & Dividing Integers with DIFFERENT SIGNS

Multiplying

Example 13 :

$-4(9) = -36$

Example 14:

$8(-7) = -56$

Dividing

Example 15:

$-49 \div 7 = -7$

Example 16:

$\frac{64}{-4} = -16$

Summary: When multiplying or dividing: If the signs are the same, the answer is positive. If the signs are different, the answer is negative.

+	+	=	+
−	−	=	+
+	−	=	−
−	+	=	−

× Multiplying & Dividing ÷

Rule: To subtract an integer,

"Keep, Change, Change" or "Add the Opposite"

Example 5:

$12 + (+7) = 19$

Example 6:

$-9 + {}^{-}4 = -13$

Example 7:

$-15 + (+3) = -12$

Example 8:

$7 + {}^{-}10 = -3$

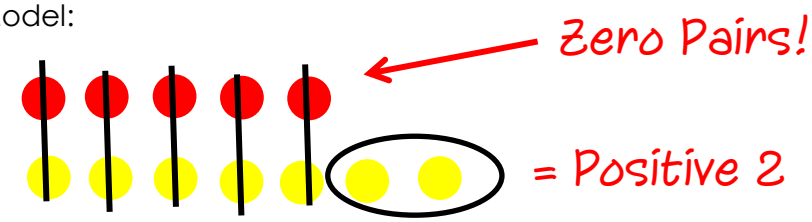
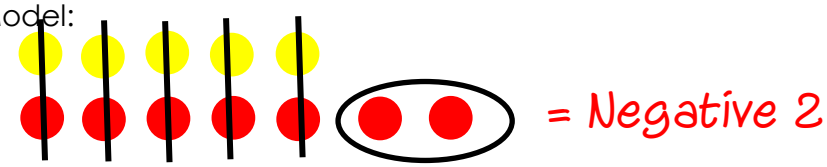
Summary: When subtracting, change the subtraction sign to addition and switch the sign of the next integer. Now it's an addition problem and you will use the same rules as we did for addition.

– Subtracting –

Multiplying & Dividing Integers with the SAME SIGNS

Multiplying	Dividing
Example 9: $6(8) =$ 48	Example 11: $24 \div 3 =$ 8
Example 10: $-11(-9) =$ 99	Example 12: $\frac{-20}{-4} =$ 5

Adding Integers with DIFFERENT SIGNS

Example 3: $-5 + 7 =$ 2	Model: 
Example 4: $5 + (-7) =$ -2	Model: 

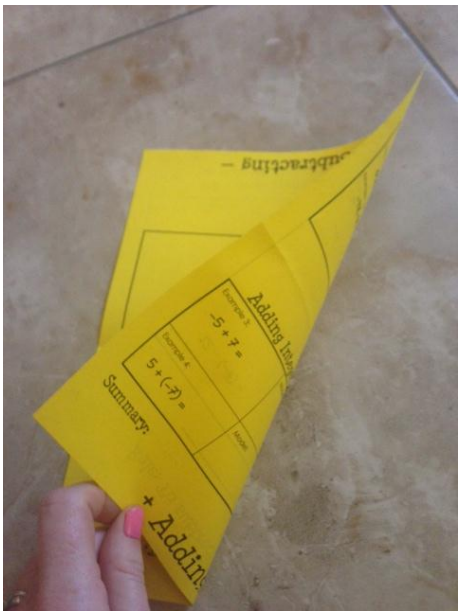
Summary: If the signs are the same, add and keep their sign.
If the signs are different, find the ***difference***, then take the sign of the integer with the larger absolute value.

+ Adding +

Directions for putting together the integer foldable!

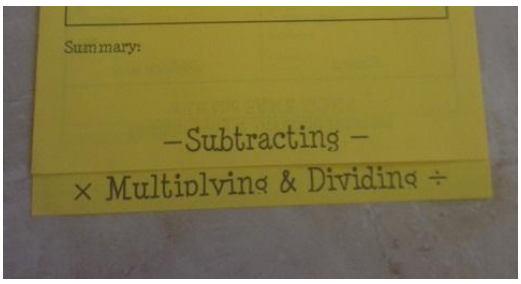
Step1: Print pages 1 & 2 front to back as shown:

Print pages 3 & 4 front to back as shown:



Step 2: Place the page that says "Multiplying & Dividing" (at the very bottom) face up on your desk.

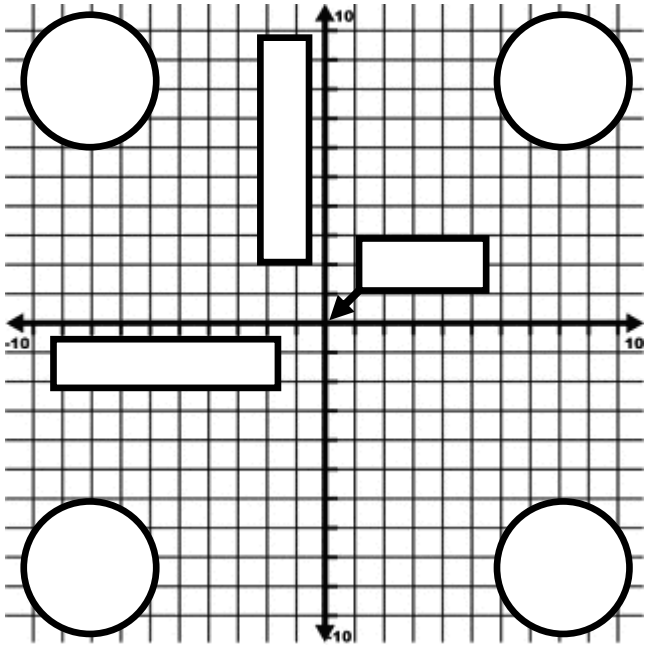
Step 3: Place the page that says "Subtracting" (at the very bottom) face up on top of the other page, so that you can just see the bottom of the original page, as shown:



Step 4: Fold over both pages so that "Adding" is just above where is says "Subtracting" and the "Integers" title is at the very top.

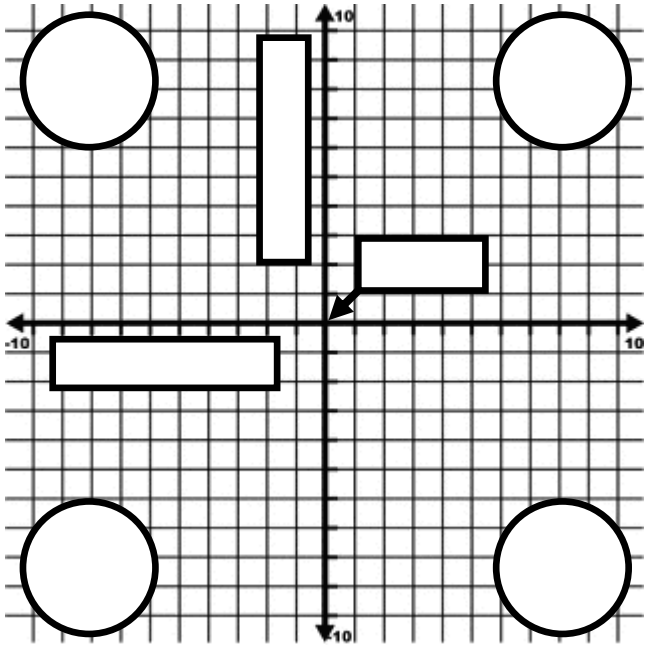
Step 4: Staple and you're done!

Graphing Ordered Pairs



(X, Y)

Graphing Ordered Pairs



(X, Y)

Interpreting Slope From a Graph or Table

Weight (in pounds)	Length of Spring (in inches)
0.0	4.0
0.5	4.8
1.0	5.6
1.5	6.4
2.0	7.2

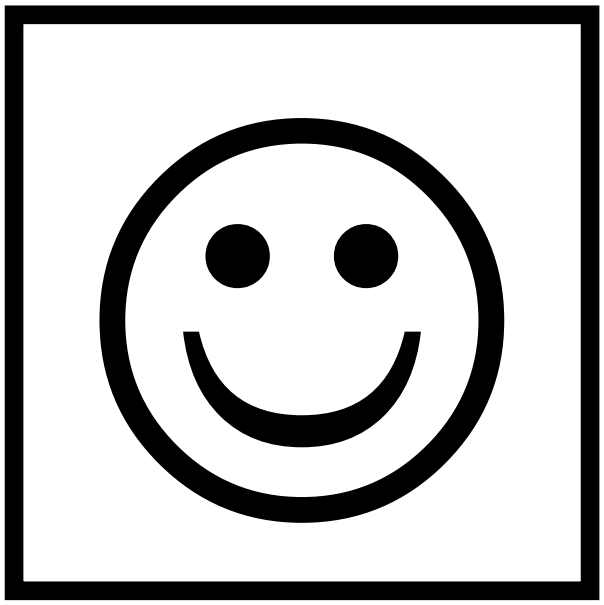
Delivery Service Charges

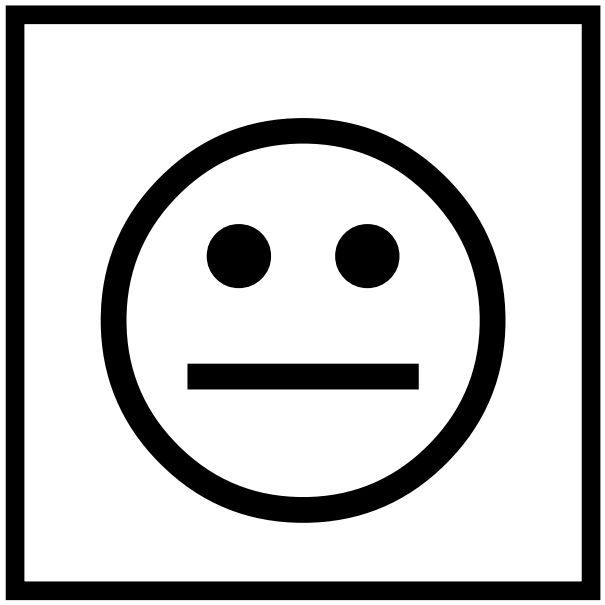
Miles Traveled	Charge
1	$14.00
2	$21.00
3	$28.00
4	$35.00

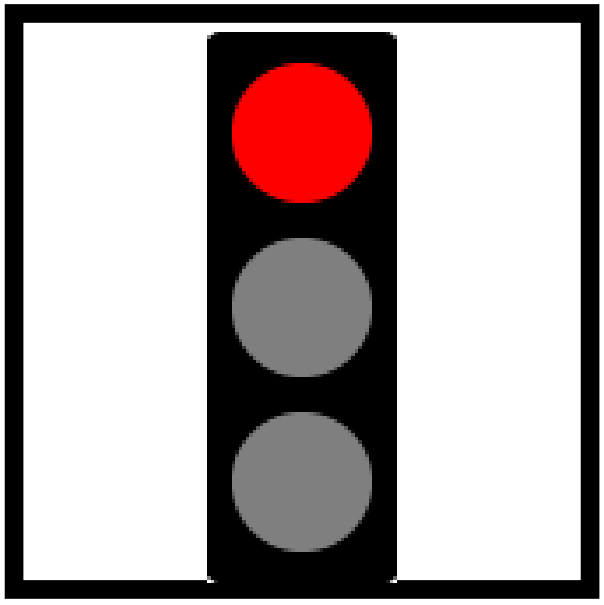
Donna's Yard Service

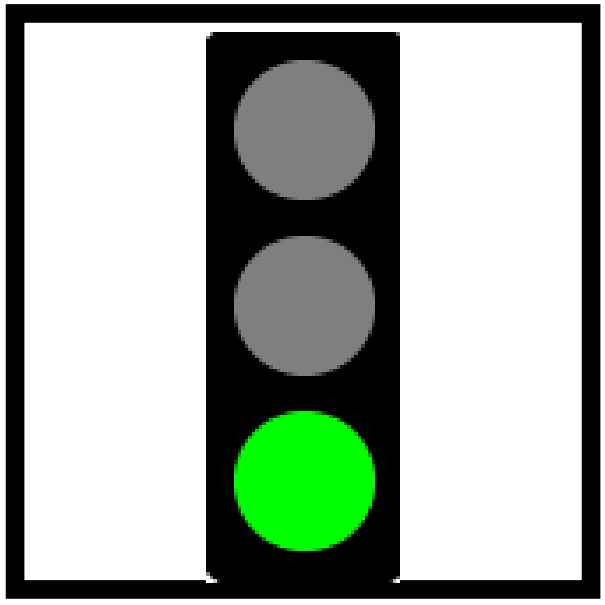
Hours Worked	1	2	3	4	5
Amount Charged	$11	$17	$23	$29	$35

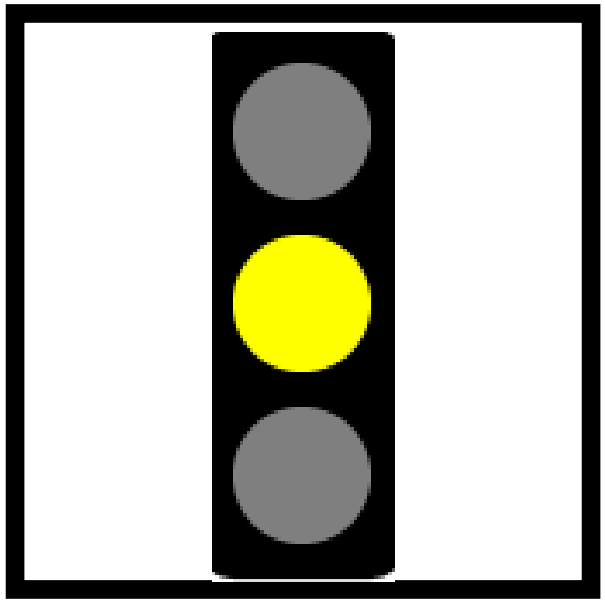
Assessment-on-a-Stick

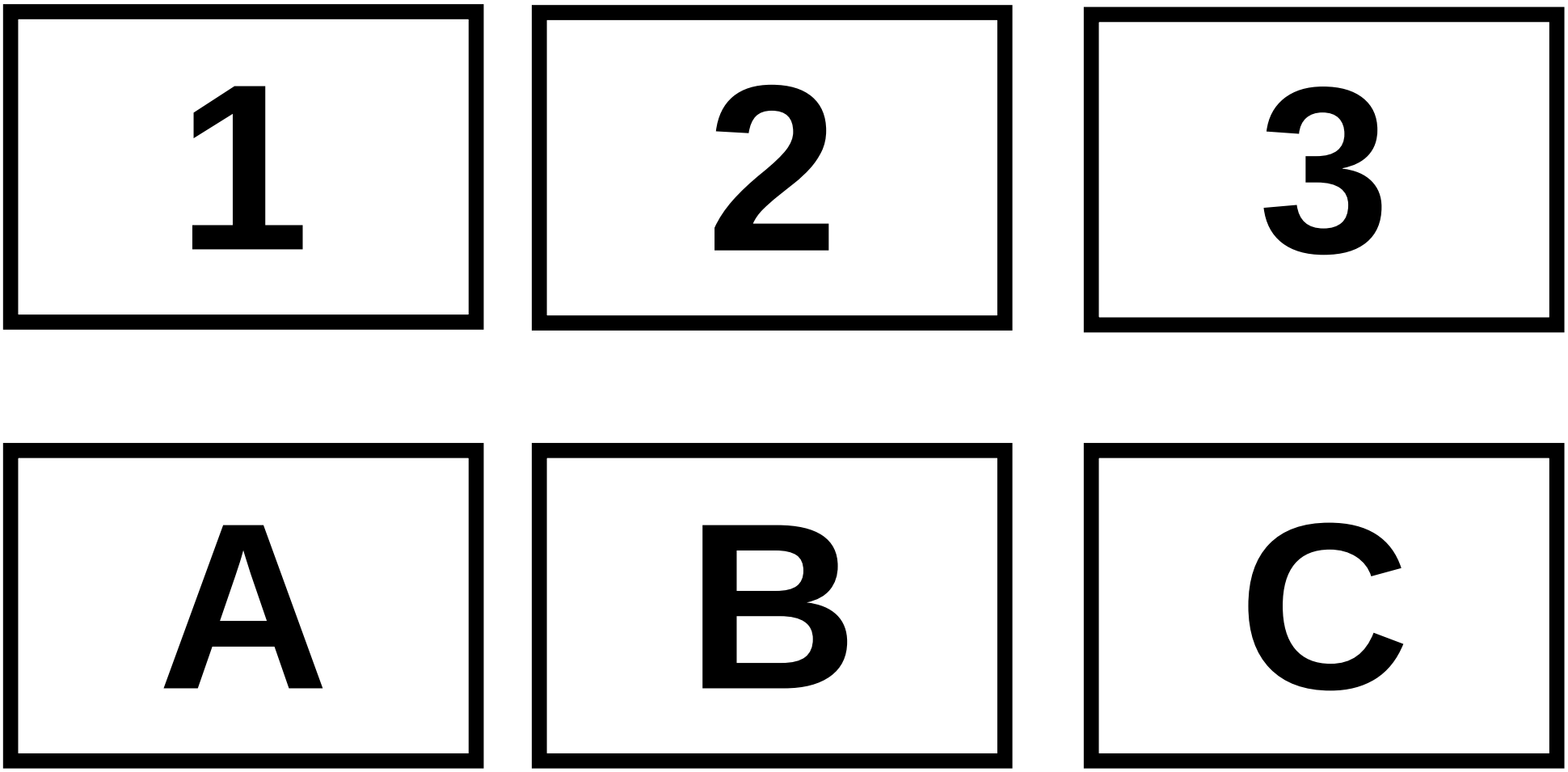




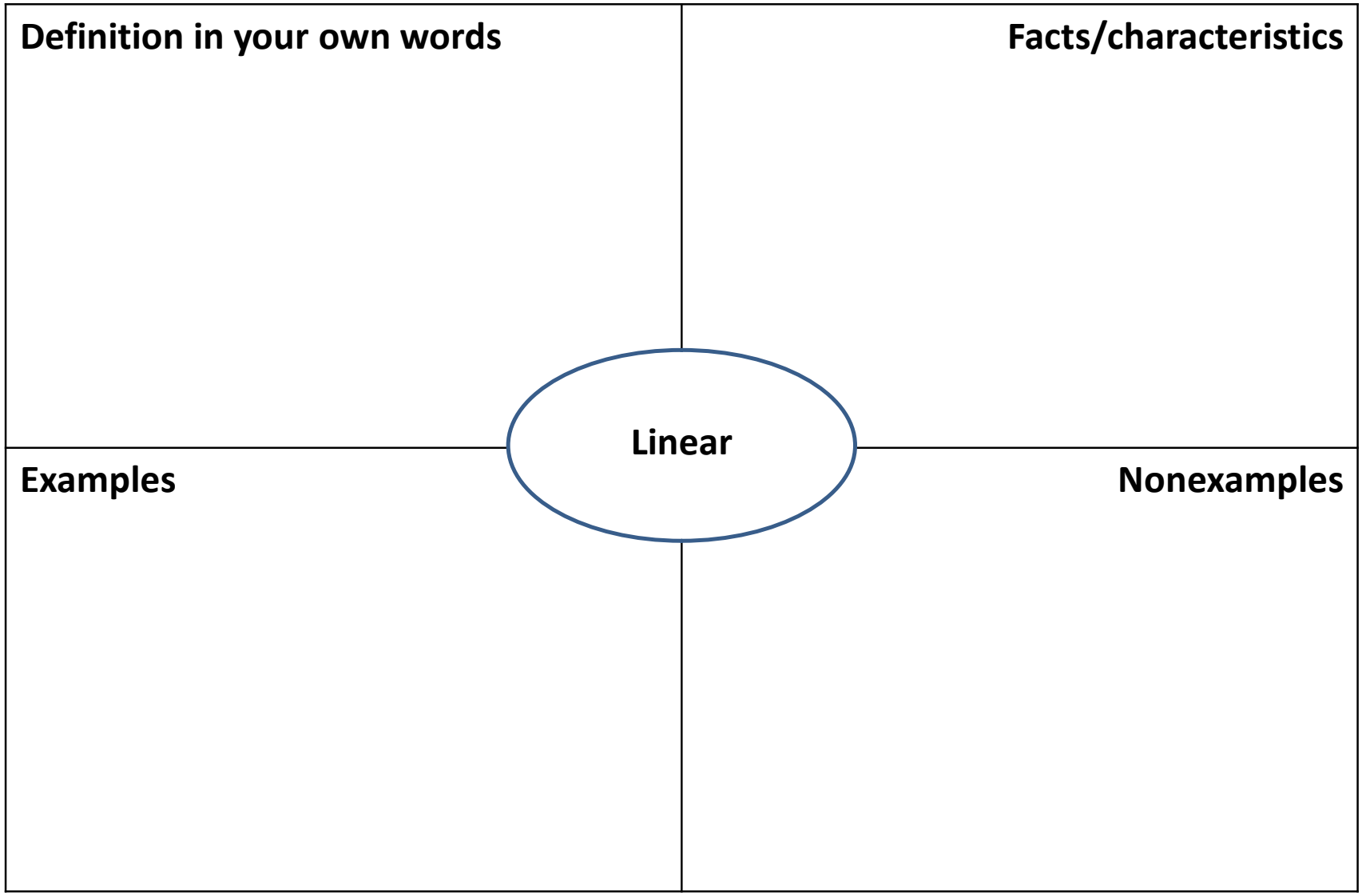







1
2
3
A
B
C

Linear Relationships



Linear Relationships graphic organizer

Math Talk

- I agree/disagree with you because...
- What I heard you say was...
- What key words helped you solve this?
- Can you explain this to me?
- What were you thinking here?
- How did you solve it?
- What did you start with?
- Why did you choose that operation?
- What strategy did you use?
- Why did you choose that strategy?
- How did you know your answer was right?
- Prove your answer is right.
- How else can you solve it?
- How did this help you understand?
- How is this like other problems you've solved?

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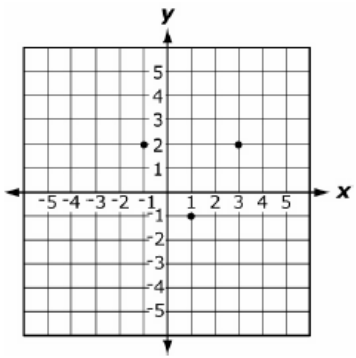
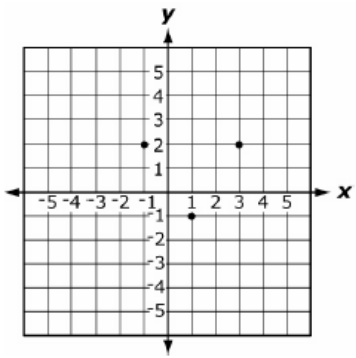
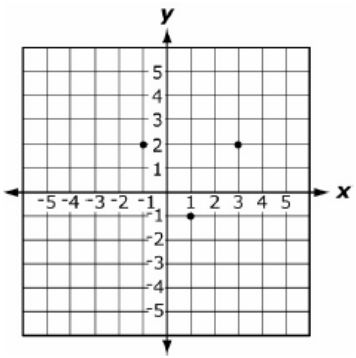


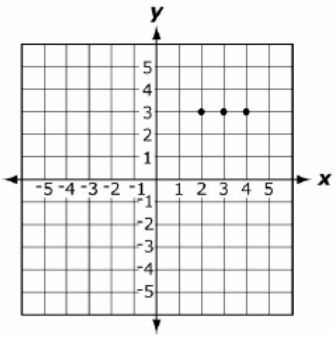
x	y
13	7
15	10
17	13
19	16



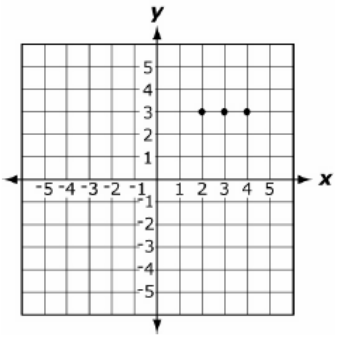
x	y
13	7
15	10
17	13
19	16



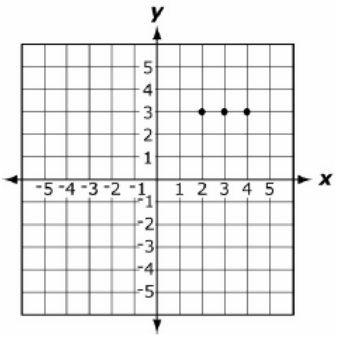
x	y
13	7
15	10
17	13
19	16



x	y
0	1
2	11
3	17
5	26



x	y
0	1
2	11
3	17
5	26



x	y
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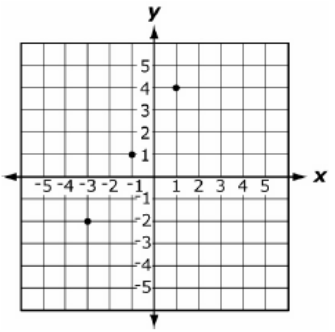
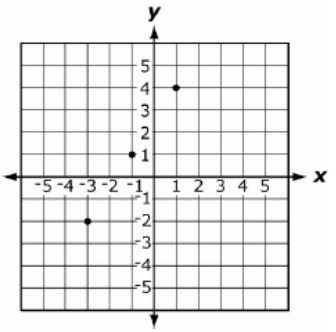


x	y
2	5
6	10
14	20



x	y
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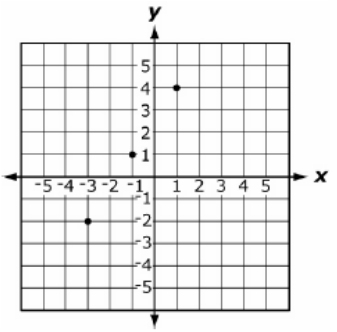
14	20



x	y
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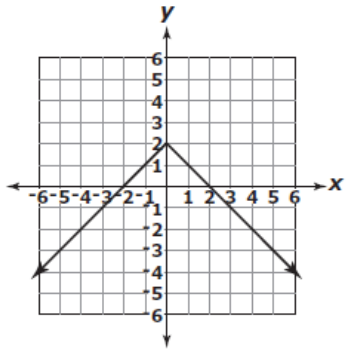
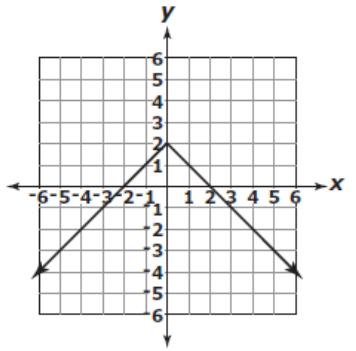


x	y
1	1
2	4
4	16
8	64



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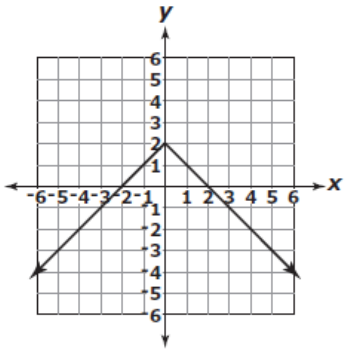

x	y
1	1
2	4
4	16
8	64

The function $f(x)$ is linear.

x	$f(x)$
−3	8
−1	11
1	14

What is the value of $f(5)$?

F −5
G 3
H 17
J 20

A functional relationship is shown in this table.

x	0	1	2	3
$f(x)$	-1	1	3	?

What is the value of the function when x is 3?

A 3
B 4
C 5
D 6

The function $f(x)$ is linear.

x	−10	−5	0	5
$f(x)$	−4	−1	2	5

What is the value of $f(15)$

F 15
G 12
H 11
J 8

The function $f(x)$ is linear.

x	$f(x)$
-2	-9
-1	-5
0	-1

What is the value of $f(2)$?

A −6
B 2
C 3
D 7

The function $f(x)$ is linear.

x	$f(x)$
−3	8
−1	11
1	14

What is the value of $f(5)$?

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A −6
B 2
C 3
D 7

All Linear Patterns

Slope and Intercept Practice

Slope:
X-Intercept:
Y-Intercept:

Slope:
X-Intercept:
Y-Intercept:

Slope:
X-Intercept:
Y-Intercept:

Slope:
X-Intercept:
Y-Intercept:

X-Intercept

The point where a graph crosses the ____________________.

X-Intercepts happen when the ______________ is __________.

To find the x-intercept from an _____________, replace ____ (or _____) with ______ and solve for __________.

X-Intercept

The point where a graph crosses the ____________________.

X-Intercepts happen when the ______________ is __________.

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The point where a graph crosses the ____________________.

X-Intercepts happen when the ______________ is __________.

To find the x-intercept from an _____________, replace ____ (or _____) with ______ and solve for __________.

Y-Intercept

The point where a graph crosses the ___________________.

Y-Intercepts happen when the ______________ is _________.

To find the y-intercept from an _____________, replace ____ with ______ and solve for _________.

Y-Intercept

The point where a graph crosses the ___________________.

Y-Intercepts happen when the ______________ is _________.

To find the y-intercept from an _____________, replace ____ with ______ and solve for _________.

Y-Intercept

The point where a graph crosses the ___________________.

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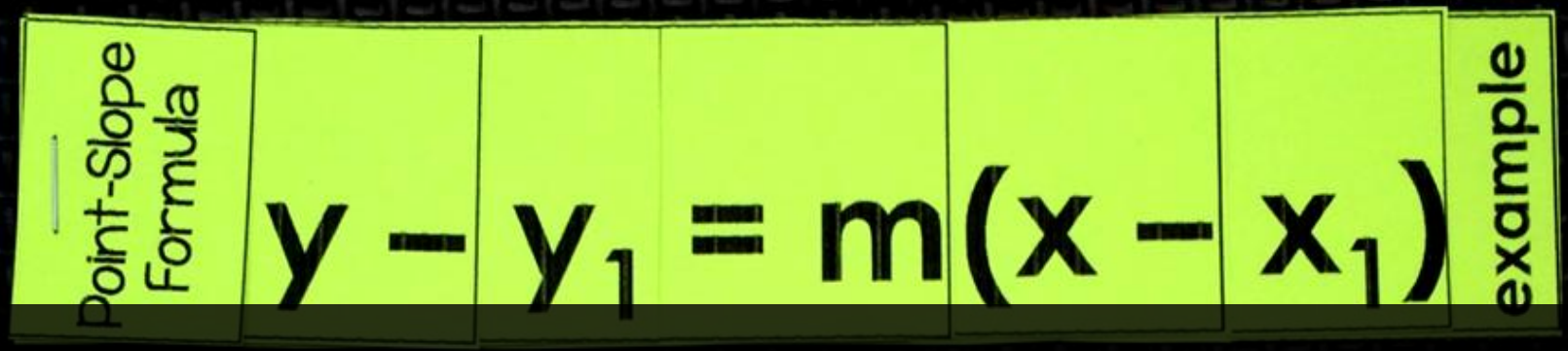
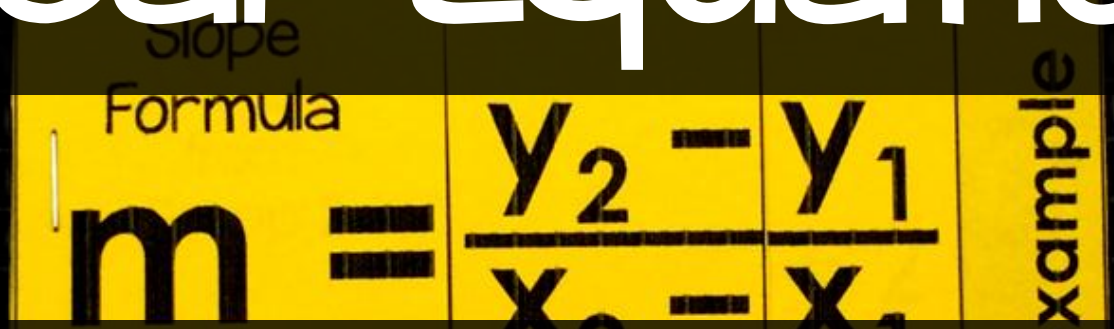


Linear Equations



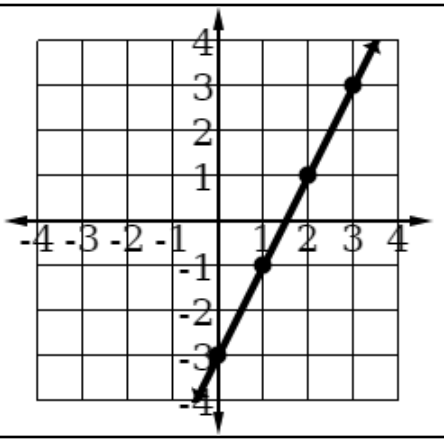
Flippables!

Scaffolded Math π Science

SLOPE

found with the Slope Formula

m



$y = 2x - 3$

"up **2**, over **1**" to get to next dot.

graph hits the y axis at (0, **-3**)

example

independent variable

Plug in any x to find y

x

1: cut between every rectangle to make 5 rectangles

2: stack rectangles on top of each other, smallest on top and largest (example rectangle) on bottom

y-intercept

Where your graph hits the y axis

+ b

Slope-intercept Equation

y =

3: staple flippable together on its left edge.

Slope Formula

$$m =$$

"Find the slope between **(3, 7)** and **(5, 11)**"

$$m = \frac{11-7}{5-3} = \frac{4}{2} = \frac{2}{1} = 2$$

example

(x, y) from Group 2

$$\frac{y_2 -}{x_2 -}$$

(x, y) from Group 1

$$\frac{y_1}{x_1}$$

1: cut between every rectangle to make 4 rectangles

2: stack rectangles on top of each other, smallest on top and largest (example rectangle) on bottom

3: staple flippable together on its left edge.

y from given (x, y) y_1

m from slope formula $= m$

example

"Find the equation of the line with slope **-4** that passes through (**3**, **9**)."

$y - 9 = -4(x - 3)$

stays x $(x -$

stays y $y -$

x from given (x, y) $x_1)$

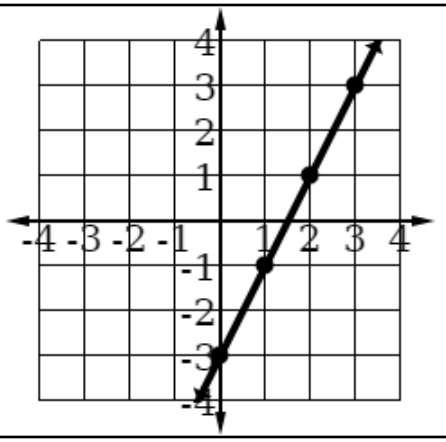
Point-Slope Formula

3: staple flippable together on its left edge.

2: stack rectangles on top of each other, smallest on top and largest (example rectangle) on bottom

1: cut between every rectangle to make 7 rectangles

m



example

x

1: cut between every rectangle to make 5 rectangles

2: stack rectangles on top of each other, smallest on top and largest (example rectangle) on bottom

+ b

Slope-intercept Equation

y =

3: staple flippable together on its left edge.

Slope Formula

$$m =$$

"Find the slope between **(3, 7)** and **(5, 11)**"

example

$$\frac{y_2 -}{x_2 -}$$

$$\frac{y_1}{x_1}$$

1: cut between every rectangle to make 4 rectangles

2: stack rectangles on top of each other, smallest on top and largest (example rectangle) on bottom

3: staple flippable together on its left edge.

Point-Slope Formula

$y - y_1 = m(x - x_1)$

example

"Find the equation of the line with slope **-4** that passes through (**3**, **9**)."

1: cut between every rectangle to make 7 rectangles

2: stack rectangles on top of each other, smallest on top and largest (example rectangle) on bottom

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Thank you!

Scrappin Doodles

Surfer Kids ClipArt

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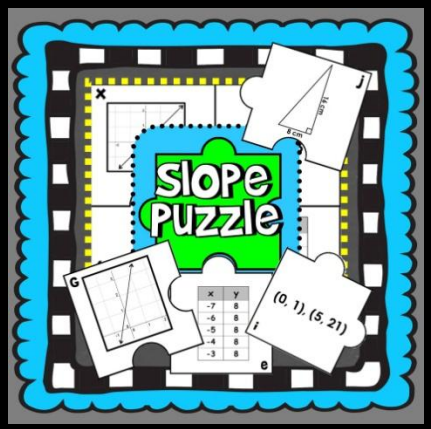

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Review