Teaching Linear Equations in Algebra 1

By Scaffolding for a Complex Task

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Abstract

This curriculum project was created to teach linear equations using scaffolding to help support student understanding of linear equations. This project includes four lessons that are presented using a stage approach to help students understand slope, slope-intercept form of a line, point-intercept of a line and linear modeling. The lessons are collaborative and involve scaffolding to build understanding by chunking smaller parts to support understanding of the overarching ideas embedded in linear equations. All lessons are aligned with the New York State Common Core standards for Algebra 1. Keys for all instructional materials are included in the appendix.

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Introduction

One of the most important foundations of higher-level mathematics is a solid understanding of linear equations. Students need to be able to find the slope, y-intercept, know how to graph these equations and solve with various equation forms when beginning with different algorithms. Many students struggle with understanding these important building blocks but even if they do not, they often find real-life applications of linear equations challenging. Indeed, learning linear equations is a complex task, which is defined in the following literature review.

There are two important challenges in teaching linear equations. The first is teaching students how to consistently and correctly pull the equations together, knowing which equation to begin with and in what form the final answer should be, and he second is modeling with linear equations. Modeling questions are some of the more important questions for students to understand because they are the ones that are more likely to be used in their life. In an effort to combat these two challenges, this curriculum project was designed using a scaffolding approach. Each lesson is treated as a smaller task to help students build confidence and understanding for the larger more complex tasks of learning linear equations.

Literature Review

The theoretical perspective of scaffolding this linear equations curriculum project was guided by the work of Van Merrienboer et al. (2006) who presented the concepts of complex tasks. A complex task is quite different than a simple task. Indeed, learning linear equations is a complex task for algebra 1 students, not a simple one. Van Merrienboer et al., (2006) defines a complex task as: having many different solutions; being ecologically valid, e.g., real world applications; requiring time to learn; and posing a very high load on the learner's cognitive system (Merrienboer, 2006, pp. 343). The four parts of a complex task relate specifically to the learning of mathematics. For example, linear equations have multiple solutions depending on which algorithm one begins. The point-slope, slope intercept, and general form of linear equations all begin with different inputs and provides different outputs. Knowing which one to use takes time to learn, and then mastering each one does too. Likewise, linear equations and solutions can also be presented graphically. Next, having real world solutions is one of the characteristics that makes learning linear equations complex for students. From, rate of growth and decline, slope and grade of roads, and systems of equations with various types of solutions, such real-world applications present why linear equations is so important. In this unit, the fourth lesson presents students options on what information they want to use to write an equation of a line using Tic Toc stars information to discuss their rise to fame. Lastly, taking time to learn and high cognitive load are intertwined. Linear equation instruction requires teachers knowing how to pace the class to cover the standards and objectives because students indeed need time to process the content because of the high cognitive load. This curriculum project builds over four lessons providing time to learn the content.

Van Merrienboer et al. (2006) also present the concept of the transfer paradox. The transfer paradox is idea that simple tasks that work from instruction that requiring routine memorization, repeated practice with constant feedback show short term success such as performance on quizzes or tests, but not on problem solving and long-term learning (Van Merrienboer, 2006). This can be quite frustrating for teachers, especially when we see how much students forget. Learning, as defined by cognitive load theory, is a permanent change in long term memory (Van Merrienboer, 2006). This implies that when students forgets, maybe they never learned the content in the first place. For linear equations this is critical because this content is used in geometry, precalculus, calculus, and statistics.

Van Merrienboer et al. (2006) also present cognitive load theory in detail, but these are not covered in this work as the focus is on how to present complex concepts in linear equations to support learning. Readers who wish to understand extrinsic, intrinsic and germane cognitive load are referred to Van Merrienboer et al. (2006). What is presented is the "part-whole approach" (p. 347) because this curriculum project used this idea to break complex tasks into smaller tasks to support learning. Basically, for mathematics teachers, this means scaffolding. So this unit scaffolds each lesson and builds from slope to slope-intercept, to point-slope and finally to linear applications. In each lesson, there is a stage concept used. This stage concept is a form of scaffolding, allowing for smaller chunks of knowledge. The exit tickets are not routine practice. These exit tickets are more complex tasks that will help for the transfer of learning and were created to avoid just repeated practice but were designed to build on the connections between each individual stage of learning linear equations.

Introduction to the Curriculum

This curriculum presents a unit of four lessons on linear functions. The lessons cover slope, slope-intercept form of a line, point-slope intercept of a line and linear applications. The lessons include a lesson plan, warm up, activity and exit ticket. The lesson plans show the learning standard, learning objective, possible questions to ask during the lesson and brief description of the lesson. All questions stem from common errors that have been noted from teaching these lessons or common places that students struggle with the content in the lesson.

The lessons were designed for 40 to 45-minute periods and are adjustable for various teaching schedules and levels of learning.

The short warmups were designed to engage students in their prior learning and collaborative learning. Teacher assigned groups might help avoid behavior issues to keep students on task. For the first three lessons, a stage approach is used. In the stage approach, students are expected to show mastery before moving to the next stage. These stages provide a natural scaffolding approach. Students might need to apply previous stages to complete further stages. It is recommended at the end of each stage that teachers check students' work for mastery. After the teacher approves the practice problems, the students can move on to further stages. Once the students have completed all the stages, they can move on to the exit ticket that involves all the stages in one assessment. The fourth lesson is broken into two stages. Students should work in their groups to complete each stage. In this lesson, there are many options for slope, so teachers need to assure that the students understand the concept of slope. Checking each pair is unrealistic as demonstrated in the one solution provided in key (see appendix).

Each lesson has a built-in formative assessment and summative assessment. The *try problems* at the end of each stage for the first three lessons and the student confidence survey in the fourth lesson are formative assessments. This information allows the teacher to know what needs to be revisited or retaught the following class. The exit ticket for each lesson serves as the summative assessment. The exit tickets would be the only recommended grading assignment for the lessons.

Lesson 1: Slope

Learning Standard:

8. F.A.3 “Construct a function to model a linear relationship between two quantities. Determine the rate of change and the initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table, or from a graph. Interpret the rate of change and initial value in terms of the situation it models and in terms of its graph or table of values.”

Learning Objective

I can find the slope from two points, or a graph.

I can translate a slope into words.

Resources:

Activity Sheet
Calculator

Lesson Overview:
Students should pick up the warm up as they walk in. And quietly start working on them. After 2-4 minutes have passed. Start by going over the learning target. Then explain to the students why it is important to be able to find the slope for future lessons and slopes use in real life applications. It is important to explain how slope is average rates of change in real life applications.

Students should work together in small groups (2-3 students). The students will start with Stage 1, once the students complete the stage, you will need to check their work. Once their answers are correct direct them to the next stage. This lesson has four stages. The students should be able to finish the stages in about 5 – 8 minutes. Try to keep them on this pace, so that you have time to complete the summative assessment.

Planned Questions:

- What number represents which coordinate?
- What happens when we subtract a negative?
- Where do the y-value go in the formula?
- Where to the x-values go in the formula?
- Other questions are included in the activity.

Assessment:

The first formative assessment is questioning during the lesson, along with the students doing problems during the lesson. I asked many different questions during the lesson to assess students’ knowledge during the lesson. Some of the questions are listed above in planned questions. Other questions are improvised by student’s responses.

The second formative assessment is the try problems at the end of each stage. Students will have you check their answers, allowing for quick assessment of their understanding.

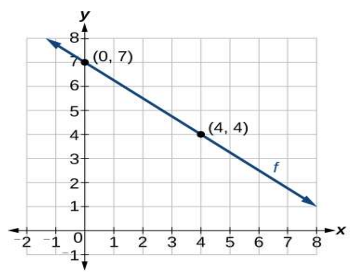
The summative assessment will be the Exit Ticket that will be given at the end of the lesson. This exit ticket is very similar to the try questions given at the end of each stage. Students will have to put all of their knowledge gain from the four stages to complete the exit ticket.

Algebra
Warm Up

Name: ________________________________ Date: _________________

1) Find the slope for the line between (3, 5) and (-2, -5).

2) Find the slope of the graph below.



Algebra
Stage 1: Independent vs. Dependent Variable

Name: ___________________________________ Date: ______________

Stage 1: Independent vs. Dependent Variable

Independent and dependent variables are important parts of both math and science classes. Being able to tell the difference between the two will help in experiments in science class and word problems in math class. Below are the definitions and important information for the two types of variables.

Independent Variable:
The independent Variable is the quantity that is being changed in an experiment or a problem. The independent variable is always the input into a function. In most problems, the variable x will represent the independent variable. We often like time to be the independent variable because cannot be affected by environmental changes.

Dependent Variable:
The dependent variable is the quantity that we are measuring by the changes in the independent variable. The dependent variable is always the output of a function. In most problems, the variable y will represent the dependent variable.

Below are some word problems, the first one has an example of the task. The task is to pick out the independent and dependent variables form the word problems and then write the two data points as an ordered pair. If you are unsure what is x and what is y, make sure to reread the definitions above. Once you have completed the task, call over the teacher to check the answers.

Example: The cost for 7 dance lessons is $82. The cost for 11 lessons is $122.

The dependent variable is the cost of the dance lessons. This is because the cost is strictly dependent on how many lessons the person is taking. (Hint: Start with the dependent variable, these are usually easier to find than the independent variable).

The independent variable is the number of dance lessons. The is because the number of dance lessons can be changed has a direct impact on the cost.

The two ordered pairs are (7, 82) and (11, 122). If the number of dance lessons are the independent variable then it will be the x values. If the cost is the dependent variable, then it will be the y-values.

Try: In 2010, the population of Wellsville, NY was 7397. In 2020, the population of Wellsville, NY was 7031.

Try: A small company makes rocking chairs. If the small company makes 100 rocking chairs and that costs them \$7500. If the company moves up to 500 rocking chairs, the cost will be \$30000.

Try: While going on a hiking trip, you notice the temperature at the base of the mountain is 24 degrees Celsius. After climbing 3500 meters, you notice the temperature is 2 degrees Celsius.

Algebra
Stage 2: Slope from Two Points

Name: ____________________________________ Date : ____________________

Stage 2: Slope from Two Points

Slope is a measurement of the steepness of a line. A more practical use of slope is finding the average rate of change of relationship. Slope is used in many real-life applications to determine a cause and effect relationship. In this center, the focus will be on finding the slope between two points. A formula to find slope is below.

$$Slope: \frac{\Delta Y}{\Delta X} = \frac{y_2 - y_1}{x_2 - x_1}$$

The Δ symbol is the Greek letter delta. For us that means the change of. So basically, slope represents the change in y (vertical) over the change in x (horizontal). The x and y represent the parts of the ordered pairs. Remember that an order pair is (x, y). Below is an example of finding the slope between two points. Read this example and then complete the try problems. Once you have completed the try problems, call over the teacher to check them.

Example: Find the slope between (2, 5) and (-2, 9).

The first part is determining what to plug into the formula and where to plug them into the formulas. Well we know an ordered pair is (x, y), we just need to determine which is the first point and which is the second point. It turns out that it does not matter, pick one to be point one and the other to be point two.

$$(2, 5) \rightarrow (x_1, y_1)$$
$$(-2, 9) \rightarrow (x_2, y_2)$$

$$\frac{\Delta Y}{\Delta X} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9 - 5}{-2 - 2} = \frac{4}{-4} = -1$$

The slope is -1. Make sure to be careful of subtracting negatives and always simplify the fraction if you can. Also, the numbers on top of each other must be from the same point.

Try: Find the slope between (1, 1) and (4, 3)

Try: Find the slope between (-2, -7) and (-3, 5).

Try: Find the slope between (9, -10) and (-1, 6).

Algebra
Stage 3: Find the slope from a Graph

Name: ___________________________________ Date: ______________

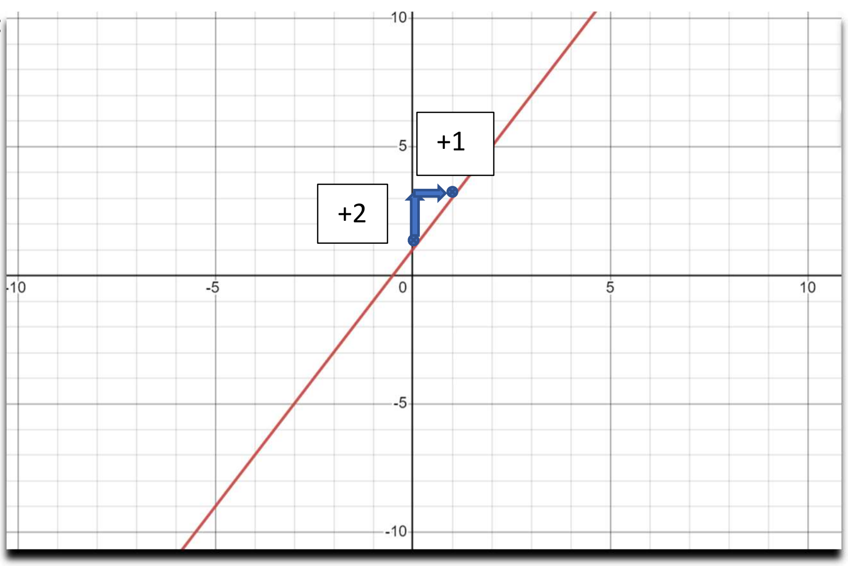
Stage 3: Finding the Slope from a Graph

The previous stage focused on finding the slope between two points. This stage focuses on finding the slope from a graph. There are two ways to accomplish this, first find two points on the graph and follow the procedure from the last center. The second option is to use the formula below.

$$Slope = \frac{\Delta Y}{\Delta X} = \frac{Rise\ (vertical)}{Run\ (horizontal)}$$

Rise is the vertical distance the line goes to go from point to point. If the line goes up, this is a positive direction and therefore the rise would be positive. If the line goes down, then this is negative direction and therefore the rise is negative. The run is the horizontal distance to go from point to point. If the line goes right, this is a positive direction and therefore the run would be positive. If the line goes left, this is a negative direction and therefore the run is negative. (Think of a coordinate plane and where the positive and negative numbers are located). Always do the run before the rise and write the rise and run as a fraction. Below is an example of finding the slope from a graph using Desmos. Read through the example and then complete the tries. Once you have completed the tries have the teacher check them.

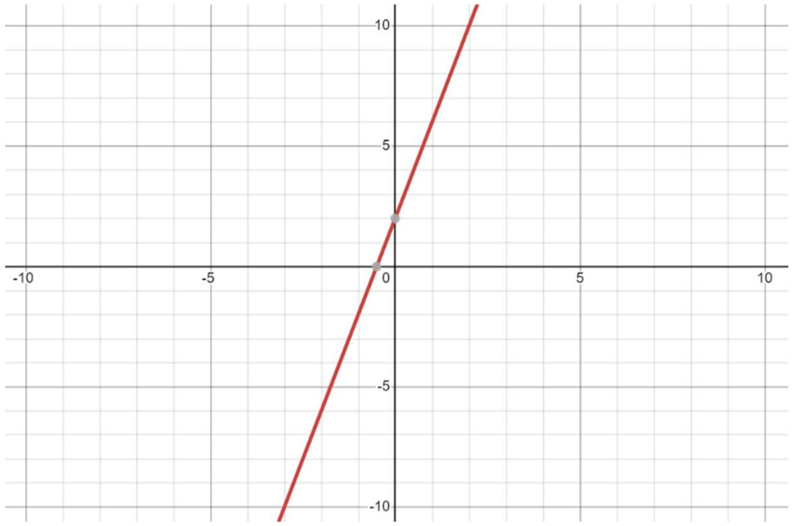
Example:



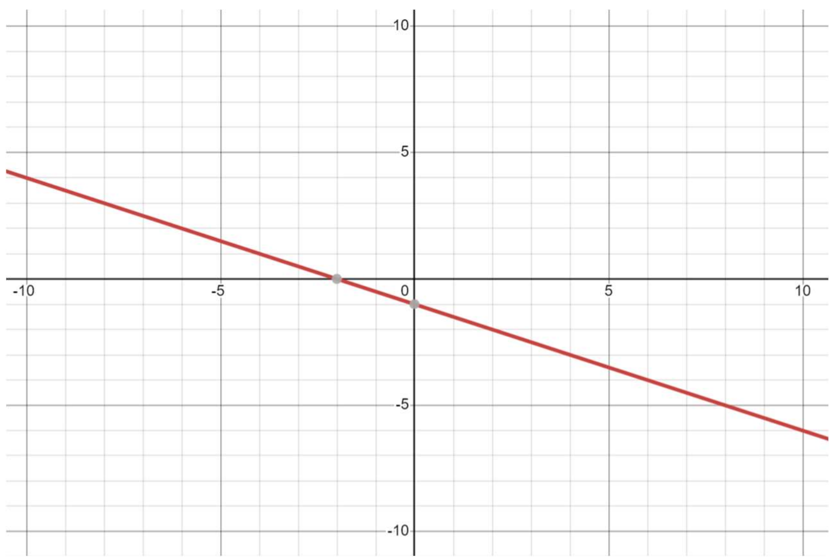
The first step is to find two points that are directly on crossing lines. Two points are marked on the graph above. It does not matter what point to start with, but generally start with the point to the left and work your way to right point. The rise is going up and goes up two. Therefore, the rise is +2. The run is going right and goes one unit. Therefore, the run is +1. Once simplified, the slope is 2.

$$Slope = \frac{\Delta Y}{\Delta X} = \frac{Rise}{Run} = \frac{+2}{+1} = 2$$

Try: Find the slope of the line below:



Try: Find the slope of the line below:



Algebra
Stage 4: Translating Slope into Words

Name: _________________________________ Date: ______________

<u>Stage 4: Translating Slope into Words</u>

The previous stages focused on finding slope. This stage will focus on what that slope means. More importantly what that slope means in terms of graphing slope. This will be needed for tomorrow's lesson. To help organize slope it is important to use the first part of the formulas we have used.

$$Slope = \frac{\Delta Y}{\Delta X}$$

The top number represents the change in the y direction. Therefore, if the slope is negative, then the line will move down. The bottom number represents the x direction. If the slope is not a fraction, remember that a one can be placed under whole number to make it a fraction. It is also important to remember there are two options for translating slope into words. The other translation is always the opposite directions for both parts of slopes. This will be important for graphing slope tomorrow. Below is an example of translating slope into words. Read through the example, and then complete the tries. Once completed, have the teacher check them.

Example: Translate the following slope into words: $\frac{-3}{4}$

$$Slope = \frac{\Delta Y}{\Delta X} = \frac{-3}{4} = \frac{Down\ 3}{Right\ 4} = \frac{3}{-4} = \frac{Up\ 3}{Left\ 4}$$

The first translation is down 3 and right 4. This is using the direct slope given and the directions. The second translation is up 3 and left 4. This is found by doing the opposite of both directions.

Try: Translate the following slope into words: $\frac{2}{5}$

Try: Translate the following slope into words: -4

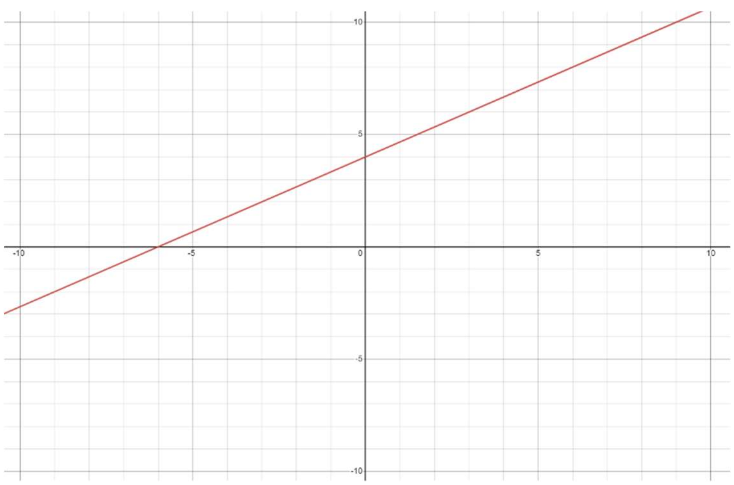
Algebra
Exit Ticket for Slope Lesson

Name: _________________________________ Date: ______________

Below are three different scenarios for slope. Which of the following has the largest slope?

1) The slope between (1, 5) and (-4, -2).

2) The slope of this line:



3) The average rate of change for the following scenario: In 1996 there was a population of 2426 hamsters in New York. In 2020, there was a population of 3218 hamsters in New York.

Lesson 2: Slope-Intercept

Learning Standard:

HSA.CED.A.1 "Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions."

Learning Objective

I can write the equation of a line in slope-intercept form from two points or a graph.

I can graph a line from the equation of a line in slope-intercept form.

Resources:

Activity Sheet
Calculator

Lesson Overview:
Students should pick up the warm up as they walk in. And quietly start working on them. After 2-4 minutes have passed, start collecting the warm ups. Start by going over the learning target. Then explain to the students about what slope-intercept form of a line is. It is important to explain how slope-intercept of a line is an equation of a line that makes it easy to graph lines and how it gives important information about the line (slope and y-intercept). And how in many cases the slope and y-intercept are the most important parts of a real life application.

Students should work together in small groups (2-3 students). The students will start with Stage 1, once the students complete the stage, you will need to check their work. Once their answers are correct direct them to the next stage. This lesson has four stages. The students should be able to finish the stages in about 5 – 8 minutes. Try to keep them on this pace, so that you have time to complete the summative assessment.

Planned Questions:

- What does the y-intercept represent?
- How do we find the y-intercept?
- How do we find the slope?
- Where is the y-axis?
- Other questions are included in the activity.

Assessment:

The first formative assessment is questioning during the lesson, along with the students doing problems during the lesson. I asked many different questions during the lesson to assess students' knowledge during the lesson. Some of the questions are listed above in planned questions. Other questions are improvised by student's responses.

The second formative assessment is the try problems at the end of each stage. Students will have you check their answers, allowing for quick assessment of their understanding.

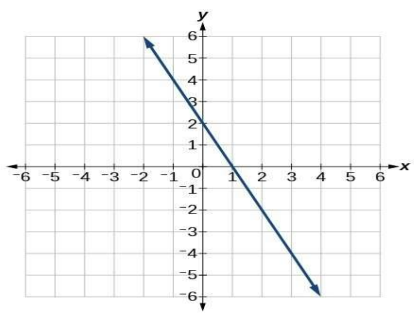
The summative assessment will be the Exit Ticket that will be given at the end of the lesson. This exit ticket is very similar to the try questions given at the end of each stage. Students will have to put all of their knowledge gain from the four stages to complete the exit ticket.

Algebra
Warm Up Slope-Intercept Form

Name: _______________________________ Date: _________________

1) Find the slope (2, 3) and (-5, -4).

2) Find the slope of the line below:



Algebra
Stage 1: Slope-Intercept Form

Name: ____________________________ Date: ______________

<u>Stage 1: Slope-Intercept Form</u>

Yesterday we worked on finding the slope of lines. Today we want to work on giving the lines names. The way we give lines names is by writing the equation of a line in terms of its slope and y-intercept. Every line is unique to its slope and y-intercept. Therefore, an equation that uses these two attributes will be unique and have its own unique name. Below is the general form of the slope intercept form, along with what the variables represent.

$$y = mx + b$$

(x, y) represent a point on the line. These could be any of the infinite amount of points that make up the line. Because of this, when we write the equation, we generally leave the x and y as variables.

m represents the slope of the line. This is always positioned in front of the x.

b represents the y-coordinate of the y-intercept. This is always being added or subtracted from the term with the x.

Now that you have seen slope-intercept form, it is important to be able to pick out the pieces of an equation already in slope intercept form. Below is an example, read through the example and then work through the try problems. Once completed have the teacher check your answers.

Example: What is the slope and y-intercept of the following equation?

$$y = 3 + \frac{-2}{5}x$$

The slope of the equation is $\frac{-2}{5}$. This can be determined by the place of the slope, which is always in front of the x. As long as the equation is in the form “y =”, and the other side is simplified, you will be able to pick out the slope by the coefficient on the x. The y-intercept is (0, 3). This is always the term being added or subtracted to or from the x term. Remember to write you y-intercept as a point. The y-intercept always has a x-coordinate of 0.

Try: What is the slope and y-intercept of the following equation?

$$y = 2x + 5$$

Try: What is the slope and y-intercept of the following equation?

$$-4 - x = y$$

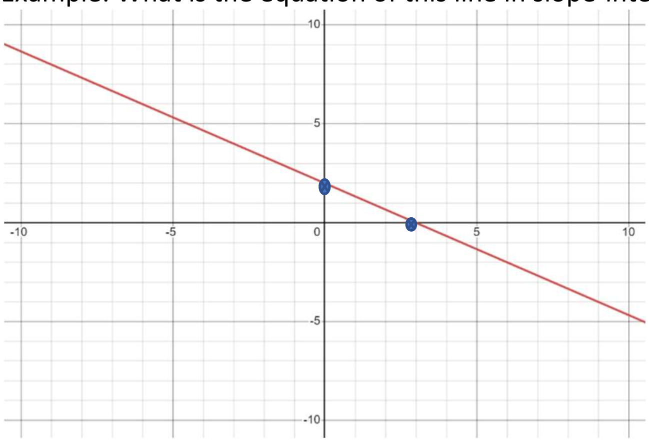
Algebra
Stage 2: Writing Slope-Intercept from a Graph

Name: ______________________________ Date: ______________

Stage 2: Writing Slope-Intercept from a Graph

Slope-Intercept form of the equation of a line is a handy tool for mathematicians. Being able to write the equation from a graph is a task, that requires you to be able to find the slope of a line from a graph and the y-intercept. Finding the slope from a graph reviews yesterday's topic (refer to yesterday's work if you need help). To pick out the y-intercept, you need to find where the line crosses the y-axis. An example is below. Read through the example and do the try problems. Once complete have the teacher check your answers.

Example: What is the equation of this line in slope-intercept form?

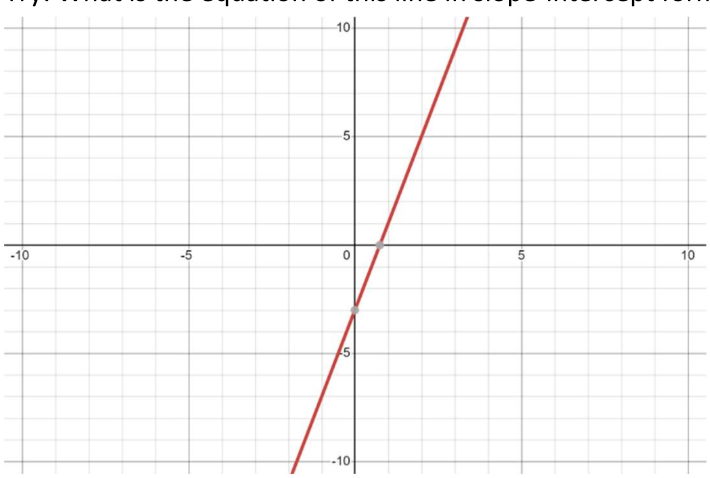


The first part is to find the slope, the graph has marked two nice points. Find the slope between these two points. Reference yesterday's lesson. The y-intercept is the point marked on the graph, where the line crosses the y-axis.

$Slope = \frac{-2}{3}$ $\quad y - intercept = (0, 2)$

$y = \frac{-2}{3}x + 2$

Try: What is the equation of this line in slope-intercept form?



Try: What is the equation of this line in slope-intercept form?

Algebra
Stage 3: Slope-Intercept from Two Points

Name: _______________________________ Date: ______________

<u>Stage 3: Slope-Intercept from Two Points</u>

In this stage, there will only be two points given. Using these two points, you can write the equation of the line in slope-intercept form. The first step is to find the slope between the two points. This is from yesterday's lesson and feel free to reference those notes from yesterday. After finding the slope, plug the slope into m, and use either of the two points to substitute into x and y. After substitution, the equation will only have one variable left, b. Solve for b and that is the y-intercept. The final step is to write the equation with only the slope and y-intercept as numbers. X and y will remain x and y. Example is included below. Read through this example and then do the try problems. Once completed, have the teacher check your answers.

Example: Find the equation of a line that goes through (4, 5) and (-8, -4) in slope-intercept form.

$$Slope = \frac{\Delta Y}{\Delta X} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4-5}{-8-4} = \frac{-9}{-12} = \frac{3}{4}$$

Find the slope first, using the slope formula. Remember to simplify your slope.

$$y = mx + b \rightarrow 5 = \frac{3}{4}(4) + b$$

Substitute a point into x and y. It does not matter which point, I picked (4, 5) because they were positive values. Make sure you put the x-coordinate in for x and the y-coordinate in for y.

$$5 = 3 + b$$

$\frac{3}{4}(4) = 3$ use your calculator if you need help with the fractions.

$$\begin{aligned} 5 &= 3 + b \\ -3 &\quad -3 \\ 2 &= b \end{aligned}$$

Subtract three from both sides to solve for b. Final step is to write your equations.

$$y = \frac{3}{4}x + 2$$

Try: Find the equation of a line that goes through (-3, 5) and (0, -4) in slope-intercept form.

Try: Find the equation of a line that goes through (3, 4) and (-6, 7) in slope-intercept form.

Try: Find the equation of a line that goes through (-6, -9) and (-2, -7) in slope-intercept form.

Algebra
Stage 4: Graphing from Slope-Intercept Form

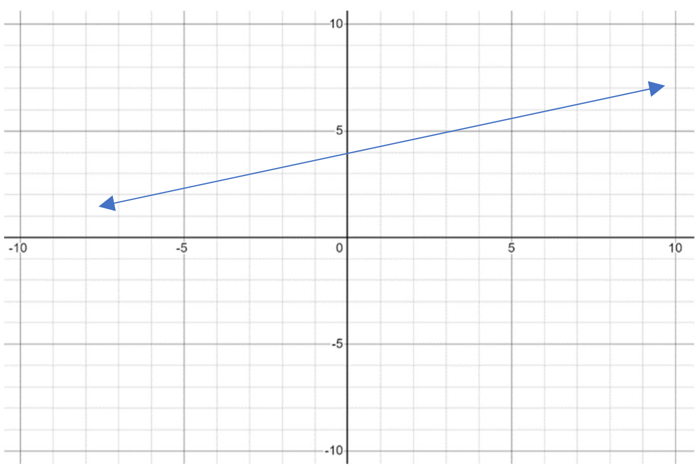
Name: ___________________________________ Date: _______________

Stage 4: Graphing from Slope-Intercept Form

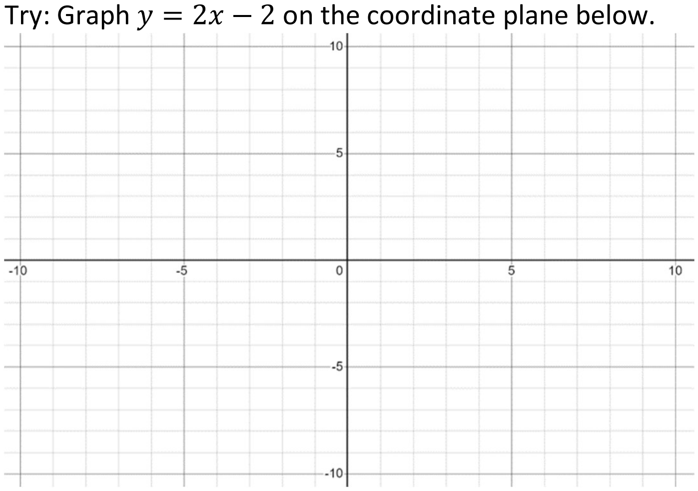
In this final stage, we will use slope-intercept to graph lines. This is basically the opposite of stage 2. Using stage 1, we will pick out the slope and y-intercept from the equation. First graph the y-intercept. Remember this is where the line crosses the y-axis. Then using the slope, we will graph points until we have no more room to graph. You will need to remember yesterday's lesson on what slope means in words. Feel free to reference the notes from yesterday. An example is below. After reading through the example, do the try problems and have the teacher check them.

Example: Graph $y = \frac{1}{3}x + 4$ on the coordinate plane.

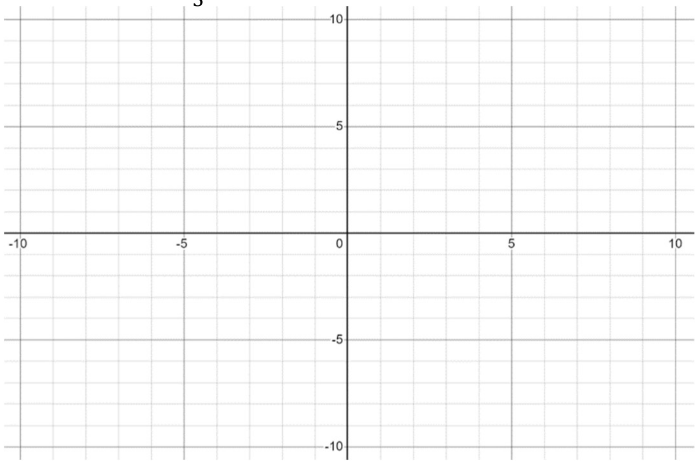
The first step is to pick out the slope and y-intercept. The slope is $\frac{1}{3}$ and the y-intercept is (0, 4). Graph (0, 4) first. After graphing the point, remember that a slope of $\frac{1}{3}$ means up one and right three. Or the other translation is down one, left three. Graph until there is no more space on the graph. Connect the points with a line. Draw arrowheads and label the line with its equation.



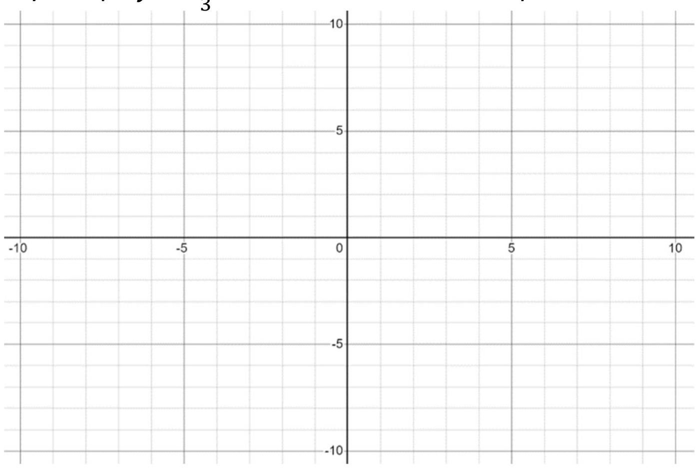
Try: Graph $y = 2x - 2$ on the coordinate plane below.



Try: Graph $y = \frac{4}{5}x + 1$ on the coordinate plane below.



Try: Graph $y = \frac{-4}{3}x + 2$ on the coordinate plane below.



Algebra
Exit Ticket for Slope Intercept

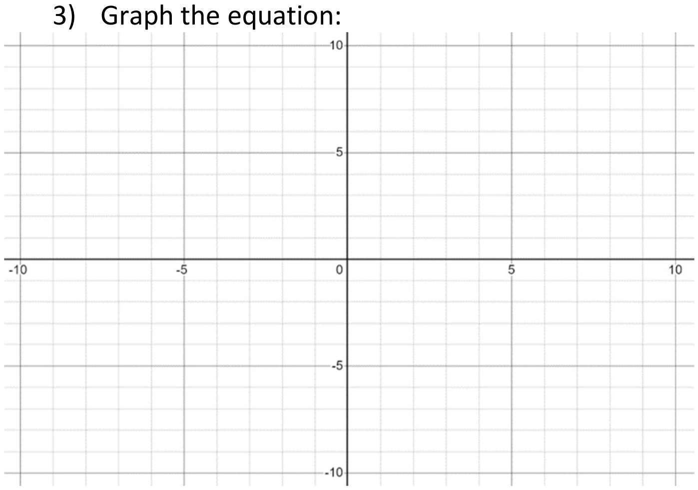
Name: _________________________________ Date: ______________

On a nice day, you decide to walk home from school. You will walk at a constant rate. After 20 minutes, you are 2 miles from home. After 40 minutes, you are 1 mile from home.

1) Write two points with x being the time walking and y being miles from home.

2) Write the equation of the line that goes between the two points. (Challenge: what does the y-intercept represent in the problem?)

3) Graph the equation:



Lesson 3: Point-Slope Form

Learning Standard:

HSA.CED.A.1 "Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions."

Learning Objective

I can model a scenario with a linear function and use that equation to solve further problems.

Resources:

Activity Sheet
Calculator

Students should pick up the warmup as they walk in. And quietly start working on them. After 2-4 minutes have passed, start collecting the warmups. Start by going over the learning target. Then explain to the students about what point-slope form of a line is. It is important to explain how it is similar to slope-intercept but is an alternative to it.

Students should work together in small groups (2-3 students). The students will start with Stage 1, once the students complete the stage, you will need to check their work. Once their answers are correct direct them to the next stage. This lesson has five stages. The students should be able to finish the stages in about 5 – 8 minutes. Try to keep them on this pace, so that you have time to complete the summative assessment.

Planned Questions:

- How do you find the slope?
- What happens when we subtract a negative?
- Which value is x and which value is y?
- Why could point-slope be easier?
- Other questions are included in the activity.

Assessment:

The first formative assessment is questioning during the lesson, along with the students doing problems during the lesson. I asked many different questions during the lesson to assess students' knowledge during the lesson. Some of the questions are listed above in planned questions. Other questions are improvised by student's responses.

The second formative assessment is the try problems at the end of each stage. Students will have you check their answers, allowing for quick assessment of their understanding.

The summative assessment will be the Exit Ticket that will be given at the end of the lesson. This exit ticket is very similar to the try questions given at the end of each stage. Students will have to put all of their knowledge gain from the four stages to complete the exit ticket.

Algebra
Warm Up Point-Slope Form

Name: _______________________________ Date: _________________

1) Find the equation of the line that goes through (0, 2) and (1, 5).

Algebra
Stage 1: Point-Slope Form

Name: ____________________________ Date: ______________

Stage 1: Point-Slope Form

Yesterday we worked on finding the slope-intercept equation of lines. These equations were a way to give the lines name. Today we will cover a second way to give these equations names. The way we give lines names is by writing the equation of a line in terms of its slope and a single point on the line. Below is the general form of the point-slope form, along with what the variables represent.

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

(x, y) represent any point on the line. These could be any of the infinite amount of points that make up the line. Much like yesterday, when we write the equation, we will leave these as x and y.

m represents the slope of the line. This is always positioned in front of the x.

(x_1, y_1) represent a single point on the line. This point can be picked at random. Unlike the x and y, you will need to have numbers in your equation. Also, be careful of negative values, to write the simplified equation you will need to rewrite double negatives as addition.

Now that you have seen point-slope form, it is important to be able to pick out the pieces of an equation already in point-slope form. Below is an example, read through the example and then work through the try problems. Once completed have the teacher check your answers.

Example: What is the slope and a point of the following equation?

$$y + 2 = 3(x - 4)$$

The slope of the equation is 3. This can be determined by the place of the slope, which is always in front of the x. The point included is (4, -2). This is always the opposite of what is being added or subtracted from the x and y. The x-coordinate goes with the x and the y-coordinate goes with the y.

Try: What is the slope and a point of the following equation?

$$y + 1 = 2(x + 5)$$

Try: What is the slope and a point of the following equation?

$$y - 2 = \frac{-2}{5}(x - 4)$$

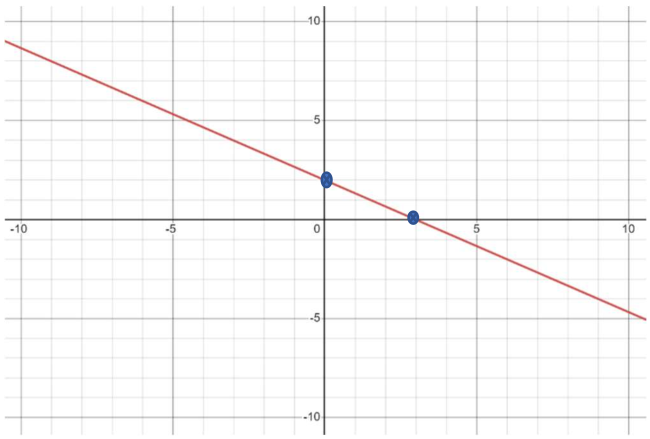
Algebra
Stage 2: Writing Point-Slope from a Graph

Name: _______________________________ Date: ______________

Stage 2: Writing Point-Slope from a Graph

Point-slope form of the equation of a line is a handy tool for mathematicians. Being able to write the equation from a graph is a task, that requires you to be able to find the slope of a line from a graph and the point referenced in the equation. Finding the slope from a graph reviews slope. To pick out the point, you need to find any point on the line. Pick a point, that is perfect and on two crossing lines. An example is below. Read through the example and do the try problems. Once complete have the teacher check your answers.

Example: What is the equation of this line in Point-Slope form?



The first part is to find the slope, the graph has marked two nice points. Find the slope between these two points. Reference the lesson from two days ago.

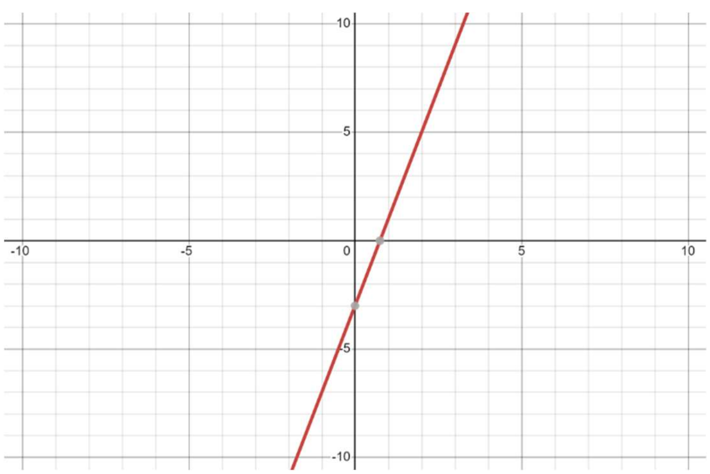
$Slope = \frac{-2}{3}$ $\quad$ $Point\ Options: (0, 2), (6, -2)$

$y—(-2) = \frac{-2}{3}(x - 6)$

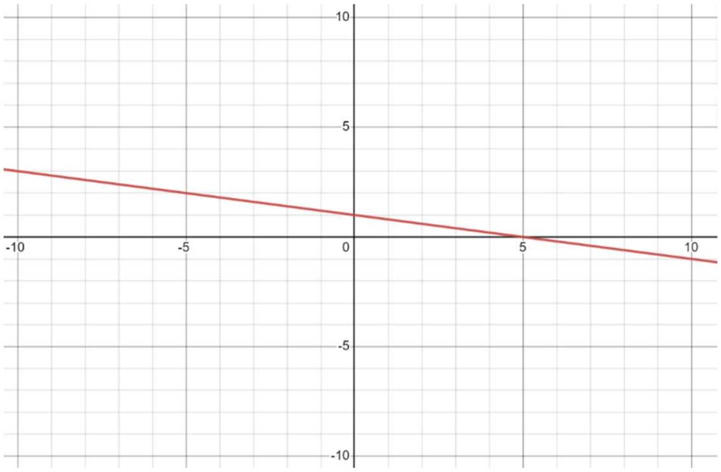
$y + 2 = \frac{-2}{3}(x - 6)$

There are many different options for this equation. It all depends on the point picked. Just remember to simplify double negatives.

Try: What is the equation of this line in point-slope form?



Try: What is the equation of this line in point-slope form?



Algebra
Stage 3: Point-Slope from Two Points

Name: _______________________________ Date: ______________

Stage 3: Point-Slope from Two Points

In this stage, there will only be two points given. Using these two points, you can write the equation of the line in slope-intercept form. The first step is to find the slope between the two points. This is from the slope lesson and feel free to reference those notes. After finding the slope, plug the slope into m, and use either of the two points to substitute into x_1 and y_1. After substitution, the equation will be complete. The final step is to simplify double negatives, by making them addition. It does not matter which point you use. Example is included below. Read through this example and then do the try problems. Once completed, have the teacher check your answers.

Example: Find the equation of a line that goes through (4, 5) and (-8, -4) in point-slope form.

$$Slope = \frac{\Delta Y}{\Delta X} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4-5}{-8-4} = \frac{-9}{-12} = \frac{3}{4}$$

Find the slope first, using the slope formula. Remember to simplify your slope.

$$y - y_1 = m(x - x_1) \rightarrow y - 5 = \frac{3}{4}(x - 4)$$

OR

$$y - y_1 = m(x - x_1) \rightarrow y - (-4) = \frac{3}{4}\big(x - (-8)\big)$$

$$y + 4 = \frac{3}{4}(x + 8)$$

Substitute a point into x_1 and y_1. It does not matter which point, I picked (4, 5) first because they were positive values. Make sure you put the x-coordinate in for x_1 and the y-coordinate in for y_1.

Try: Find the equation of a line that goes through (-3, 5) and (0, -4) in point-slope form.

Try: Find the equation of a line that goes through (3, 4) and (-6, 7) in point-slope form.

Try: Find the equation of a line that goes through (-6, -9) and (-2, -7) in point-slope form.

Algebra
Stage 4: Graphing from Point-Slope Form

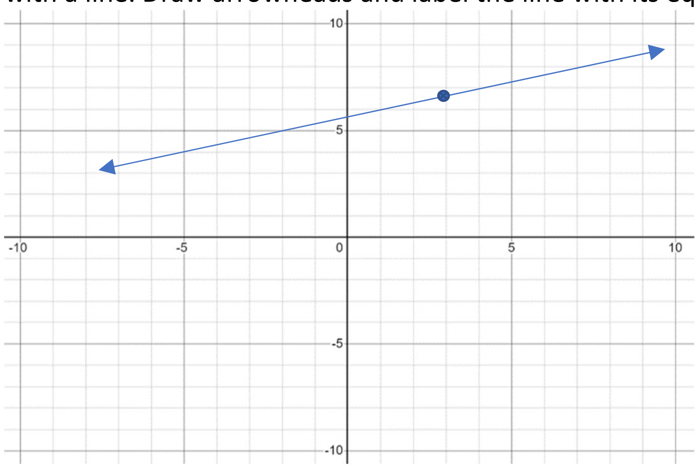
Name: ________________________________ Date: ______________

<u>Stage 4: Graphing from Point-Slope Form</u>

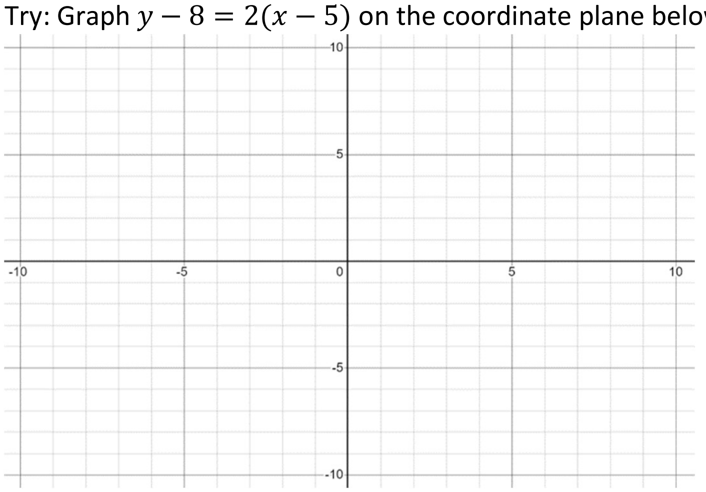
In this final stage, we will use point-slope to graph lines. This is basically the opposite of stage 2. Using stage 1, we will pick out the slope and a point from the equation. First graph the point. Remember the coordinates will be the opposite of addition and subtraction. Then using the slope, we will graph points from the graphed point until we have no more room to graph. You will need to remember the slope lesson on what slope means in words. Feel free to reference the notes. An example is below. After reading through the example, do the try problems and have the teacher check them.

Example: Graph $y - 5 = \frac{1}{3}(x - 3)$ on the coordinate plane.

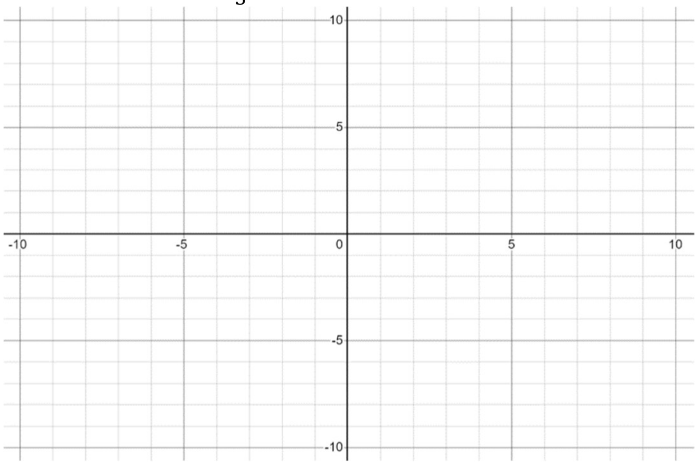
The first step is to pick out the slope and the point. The slope is $\frac{1}{3}$ and the point is (3, 5). Graph (3, 5) first. After graphing the point, remember that a slope of $\frac{1}{3}$ means up one and right three. Or the other translation is down one, left three. Graph until there is no more space on the graph. Connect the points with a line. Draw arrowheads and label the line with its equation.



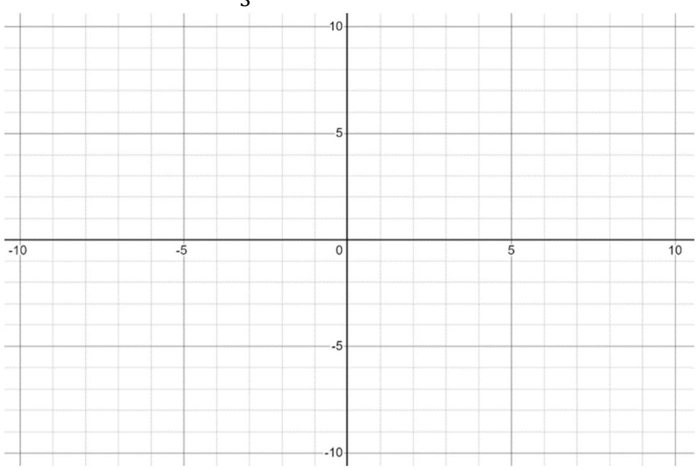
Try: Graph $y - 8 = 2(x - 5)$ on the coordinate plane below.



Try: Graph $y + 7 = \frac{4}{5}(x + 10)$ on the coordinate plane below.



Try: Graph $y + 2 = \frac{-4}{3}(x - 3)$ on the coordinate plane below.



Algebra
Stage 5: Point-Slope to Slope-Intercept

Name: ________________________________ Date: ______________

Stage 5: Point-Slope to Slope-Intercept

This lesson has one final stage, and that is being able to take point-slope and write it in slope-intercept form. The reason we need to be able to do this, is because having the y-intercept is important in many real-world applications. Instead of completing all the work needed to get a second equation, we can just take point-slope and put it into slope-intercept form. First it is important to look at the two equations to notice the difference.

$$y = mx + b$$
$$y - y_1 = m(x - x_1)$$

The major difference in the equations is that slope-intercept has the y on a side all by itself. Slope-intercept also does not have any parenthesis. So, if we take point-slope and get rid of the parenthesis (by the distributive property) and get the y on a side by itself, it will be in slope-intercept form. Below is an example of how to do this. Read through the example and then do the try problems. Once completed have the teacher check your answers.

Example: What is $y + 5 = \frac{1}{2}(x - 4)$ in slope-intercept form?

$$y + 5 = \frac{1}{2}(x - 4)$$

Distribute the slope first.

$$y + 5 = \frac{1}{2}x - \frac{1}{2}(4)$$
$$y + 5 = \frac{1}{2}x - 2$$

Solve for y, by subtracting five from both sides.

$$y + 5 - 5 = \frac{1}{2}x - 2 - 5$$
$$y = \frac{1}{2}x - 7$$

Try: What is $y - 1 = \frac{-2}{3}(x + 7)$ in slope-intercept form?

Try: What is $y - 8 = 7(x + 9)$ in slope-intercept form?

Algebra
Exit Ticket for Point Slope

Name: ___________________________ Date: _____________

Two linear functions are below. One of the functions will be the answer to each question.

$y - 5 = 3(x + 2)$

1) Which function has a negative slope?

2) Which function goes through (-2, 5)?

3) Which function has an equation of $y = 3x + 11$?

4) What is the point-slope formula of the graphed function?

Lesson 4: Linear Modeling

Learning Standard:

F. LE. 2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

Learning Objective

I can model a scenario with a linear function and use that equation to solve further problems.

Resources:

Activity Sheet

Lesson Overview:

Start by going over the learning target. Then explain to the students why it is important to be able to use linear functions in real life applications. It is important to explain how linear functions are used in real life to estimate rates of change.

This lesson should be completed in pairs. Have the students read through the activity and work together. Circulate around to help solve any problems that may arise.

Planned Questions:

- What does the y-intercept represent?
- How do we find the y-intercept?
- How do we find the average rate of change?
- Why would a linear function be a good option for estimating?
- Other questions are included in the activity.

Assessment:

The first formative assessment is questioning during the lesson, along with the students doing problems during the lesson. I asked many different questions during the lesson to assess students' knowledge during the lesson. Some of the questions are listed above in planned questions. Other questions are improvised by student's responses.

The second formative assessment is a reflective assessment for the students at the conclusion of the lesson. This will access their confidence in being able to complete a few key parts of today lesson. It is important for students to reflect on their own understanding.

The summative assessment will be the Exit Ticket that will be given at the end of the lesson. This exit ticket uses a specific example from Tik Tok to see if the students truly understands how to create a linear equation and if they have the ability to use that equation to answer further questions.

Algebra
Activity on Linear Modeling

Name: _______________________________ Date: ______________

Before we start the activity let's go over some important questions.

1) What is a linear function?

2) How do you find the average rate of change?

3) What is the general form of slope intercept form? What do the variables mean?

4) What is an independent variable? What is a dependent variable? Which variables in slope intercept form, might represent both of those variables?

Background:

Tik Tok is a Social Media platform that allows users to express themselves musically through short videos. The videos can include dancing, singing or playing musical instruments. It has grown in popularity over the past couple years.

The Next Page will include a table of famous Tik Tokers. We will be referencing this page for our activity.

Table 1: Famous Tik Tokers Information (As of 2020)

Name	Followers (Millions)	Likes (Millions)	Time (Months)	Type	Net Worth (Millions of Dollars)
Charli D'Amelio	107	8418	20	Dancer/Social Media Personality	8
Lil' Huddy	29	1529	10	Social Media Personality	0.5
Dixie D'Amelio	48	2795	13	Singer, Actress, Social Media Personality	3

Addison Rae	75	4732	18	Dancer/Social Media Personality	2
Noah Beck	24	1447	12	Social Media Personality	0.5
Josh Richards	24	1524	73	Social Media Personality	1.5
Zach King	55	662	59	Film Maker, Social Media Personality	3
Baby Ariel	35	1881	69	Singer, Actress, Social Media Personality	6
Avani Gregg	31	2167	14	Social Media Personality	20
Loren Gray	51	2712	72	Singer, Dancer, Social Media Personality	10

Table 2: Famous Tik Tokers Surpassed in Followers

Name	Numbers of Followers (In Millions)	Date Surpassed	Months on Tik Tok when surpassed	Who Surpassed them
Baby Ariel	19	April 2017	24	Lisa and Lena
Loren Gray	41	March 2020	62	Charli D'Amelio

1) Pick your favorite Tik Toker of the 10 on the list and write down what you enjoy about them. Maybe describe your favorite Tik Tok that they made. If you do not use Tik Tok, come up with a question or two you would you be interested in asking a top Tik Tok star?

2) If we think about the starting process of becoming a star on Tik Tok, how many followers would someone start with? What might this represent when we think about a linear equation (think about y = mx + b)

3) Which of those columns listed above might be the best choice for the independent variable?

4) Which of those columns would be a good choice for dependent variable? Or which would you be most interested in looking at?

5) Now that we have an independent and dependent variable, let's write some points so that we can find the Average Rate of Change. We need at least two points.

6) What is the average rate of change between the two points?

7) What is the y-intercept of the equation?

8) What would be the equation we came up with?

Part II

Let's look at Loren Grey's change in followers.

1) If we use time on Tik Tok (in months) as our independent variable and followers as our dependent variable. What are two points we can make for Loren Gray using both tables?

2) What is the average rate of change in followers for Loren Gray?

3) What would be the y-intercept for Loren Gray followers? What does the y-intercept represent in the problem?

4) Write a linear equation to represent Loren Gray's followers over time.

5) Why is this equation unrealistic?

6) Let's assume it is correct for a short time interval. How many followers would Loren Gray have after 60 months?

7) How long would it take for Loren Gray to a 100 million fans?

In Conclusion:

- If we are given two points, we can write a linear equation to represent the scenario:
  - True or False
- Linear equations are good representations for all types of data:
  - True or False
- I need to know the independent and dependent variable in a word problem before I can find the average rate of change:
  - True or False
- After writing a linear equation, I can find an output or input with ease:
  - True or False
- Rate the following on a scale of 1 being no confidence and 5 being Extremely confident
  - I can find the average rate of change: _______________
  - I can write an equation of linear scenario: _______________
  - I can use that equation to solve for other inputs or outputs: _______________

Algebra
Exit Ticket on Linear Modeling

Name: ___________________________________ Date: ______________

Below is a chart for Baby Ariel followers on Tik Tok verse her time on Tik Tok. Use the information in the chart to answer the questions.

Months on Tik Tok	Number of Followers (in Millions)
24	19
68	35

1) What is the average rate of change of the number of followers?

2) What is a linear equation that we could use to represent the change in followers for Baby Ariel?

3) Is this a realistic equation? Why or why not?

4) Using the equation, how many followers would Baby Ariel have after a year?

5) How long would it take for Baby Ariel to have 50 million followers?

This Curriculum in the Classroom

This curriculum was created to help students understand the complex task of linear functions. In the classroom it all began with linear modeling, and I noticed that students were engaged from the very start of the lesson. The relatability of the lesson to their lives piqued their interest. Beginning the lesson with a discussion on Tik Tok helped to shed light on students' personal interest. Researching their favorite Tik Tok stars helps build a connection between student interest and mathematics. Many students engaged in this lesson and helped get instant buy in from other students. After experiencing student success with linear modeling, the three prior lessons in this curriculum project were created to generate this unit of instruction.

The first three lessons I have not taught in the classroom. I have not taught these lessons, because these are new and have been made to replace the lessons that I previously taught for slope, slope-intercept form of a line and point-slope form of a line. The reason why I felt the need to change the lessons that lead up to the linear modeling lesson is because students were struggling completing the linear modeling lesson. Students often breezed through the lessons that lead up, did well on the exit tickets, so their understanding of the topic seemed to be good. But when students had to apply that understanding to linear modeling, they could not do it. My students were struggling with the transfer paradox. Students seemed to learn the concepts, but they did not learn them. So, it was important to do more scaffolding to help student not only understand the topics better, but to see how they relate better. I also designed the lessons before the most difficult one to be more complex which may help students with the learning tasks.

The new lessons will be more beneficial for students learning for a few different reasons. The first reason is the tasks will not be simple tasks anymore. In the past when teaching slope, slope-intercept form of a line and point-slope form of a line, it was straight forward. Students would learn the formulas and do a few easy problems and be all set. The problem is this rogue procedure is good when students get a straightforward problem that tells them exactly what to do but struggle with linear modeling questions. The new lessons still teach those skills, but students make for a more complex task that will help students retain the information better. The exit tickets are more complex problems that will make students think before they get to the linear modeling lesson. They also have problems that scaffold towards linear modeling. The second reason I believe that these lessons will help students learn is because of the scaffolding. The parts the students learn are smaller and each stage builds off the other to help with the connections that students need to be able to understand for linear equations.

As for the challenges that come with teaching the lesson, time was the biggest challenge. I strongly recommend using a timer to help students stay on a pace to finish their work. Also organizing student groups might be beneficial, depending on the classroom dynamics. There is a lot of reading to complete the questions, so helping students who struggle with reading will be something that needs to be address. Students also will need to recall prior learning so when students ask for help, it is important to ask leading questions and not justs give them answers. This is a complex task and making them think through the process is important to their learning.

Conclusion

Learning linear equations is a complex task. Students often struggle with this important building block of algebra. And often if students learn the skills necessary for linear equations, being to apply these skills to a real-life application or recall them in calculus is difficult. Because of this difficulty these lessons were created to help students with linear equations. By using scaffolding and working on a complex task these lessons help students learn linear equations better and help the students with the transfer paradox of learning. The answer keys to the lessons can be found in the appendix for the reader’s reference. As teacher’s it is important to gain as many resources as we can to teach our students and hopefully this curriculum can help you in your teaching.

References

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Van Merrienboer, J. J. G., Kester, L., & Paas, F. (2006). Teaching Complex Rather Than Simple Tasks: Balancing Intrinsic and Germane Load to Enhance Transfer of Learning [Review of *Teaching Complex Rather Than Simple Tasks: Balancing Intrinsic and Germane Load to Enhance Transfer of Learning*]. *Applied Cognitive Psychology*, *20*, 343–352.

Appendix

The answer keys for the curriculum are found on the next few pages.

Algebra
Warm Up

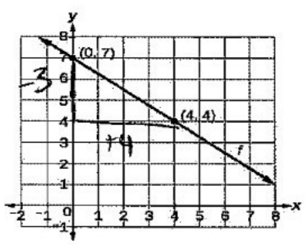
Name: Key Date: ____________

1) Find the slope for the line between (3, 5) and (-2, -5).

$x_1\ y_1 \quad x_2\ y_2$

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5-5}{-2-3} = \frac{-10}{-5} = 2$$

2) Find the slope of the graph below.



$$\frac{\Delta y}{\Delta x} = \frac{-3}{4}$$

Algebra
Stage 1: Independent vs. Dependent Variable

Name: Key Date: ____________

Stage 1: Independent vs. Dependent Variable

Independent and dependent variables are important parts of both math and science classes. Being able to tell the difference between the two will help in experiments in science class and word problems in math class. Below are the definitions and important information for the two types of variables.

Independent Variable:
The independent Variable is the quantity that is being changed in an experiment or a problem. The independent variable is always the input into a function. In most problems, the variable x will represent the independent variable. We often like time to be the independent variable because cannot be affected by environmental changes.

Dependent Variable:
The dependent variable is the quantity that we are measuring by the changes in the independent variable. The dependent variable is always the output of a function. In most problems, the variable y will represent the dependent variable.

Below are some word problems, the first one has an example of the task. The task is to pick out the independent and dependent variables form the word problems and then write the two data points as an ordered pair. If you are unsure what is x and what is y, make sure to reread the definitions above. Once you have completed the task, call over the teacher to check the answers.

Example: The cost for 7 dance lessons is $82. The cost for 11 lessons is $122.

The dependent variable is the cost of the dance lessons. This is because the cost is strictly dependent on how many lessons the person is taking. (Hint: Start with the dependent variable, these are usually easier to find than the independent variable).

The independent variable is the number of dance lessons. The is because the number of dance lessons can be changed has a direct impact on the cost.

The two ordered pairs are (7, 82) and (11, 122). If the number of dance lessons are the independent variable then it will be the x values. If the cost is the dependent variable, then it will be the y-values.

x y x
Try: In 2010, the population of Wellsville, NY was 7397. In 2020, the population of Wellsville, NY was 7031.
y
(2010, 7397) (2020, 7031

x

Try: A small company makes rocking chairs. If the small company makes 100 rocking chairs and that costs them $7500. If the company moves up to 500 rocking chairs, the cost will be $30000.

y x y

(100, 7500) (500, 30000)

x y

Try: While going on a hiking trip, you notice the temperature at the base of the mountain is 24 degrees Celsius. After climbing 3500 meters, you notice the temperature is 2 degrees Celsius.

(0, 24) (3500, 2)

Algebra
Stage 2: Slope from Two Points

Name: Key Date :

Stage 2: Slope from Two Points

Slope is a measurement of the steepness of a line. A more practical use of slope is finding the average rate of change of relationship. Slope is used in many real-life applications to determine a cause and effect relationship. In this center, the focus will be on finding the slope between two points. A formula to find slope is below.

$$Slope: \frac{\Delta Y}{\Delta X} = \frac{y_2 - y_1}{x_2 - x_1}$$

The Δ symbol is the Greek letter delta. For us that means the change of. So basically, slope represents the change in y (vertical) over the change in x (horizontal). The x and y represent the parts of the ordered pairs. Remember that an order pair is (x, y). Below is an example of finding the slope between two points. Read this example and then complete the try problems. Once you have completed the try problems, call over the teacher to check them.

Example: Find the slope between (2, 5) and (-2, 9).

The first part is determining what to plug into the formula and where to plug them into the formulas. Well we know an ordered pair is (x, y), we just need to determine which is the first point and which is the second point. It turns out that it does not matter, pick one to be point one and the other to be point two.

$$(2, 5) \rightarrow (x_1, y_1)$$
$$(-2, 9) \rightarrow (x_2, y_2)$$

$$\frac{\Delta Y}{\Delta X} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9 - 5}{-2 - 2} = \frac{4}{-4} = -1$$

The slope is -1. Make sure to be careful of subtracting negatives and always simplify the fraction if you can. Also, the numbers on top of each other must be from the same point.

Try: Find the slope between (1, 1) and (4, 3)
$x_1 y_1$ $x_2 y_2$

$$\frac{\Delta Y}{\Delta X} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3-1}{4-1} = \frac{2}{3}$$

Try: Find the slope between (-2, -7) and (-3, 5).
$x_1 \; y_1 \quad x_2 \; y_2$

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5-(-7)}{-3-(-2)} = \frac{12}{-1} = -12$$

Try: Find the slope between (9, -10) and (-1, 6).
$x_1 \; y_1 \quad x_2 \; y_2$

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6-(-10)}{-1-9} = \frac{16}{-10} = -\frac{8}{5}$$

Algebra
Stage 3: Find the slope from a Graph

Name: Key Date: ______________

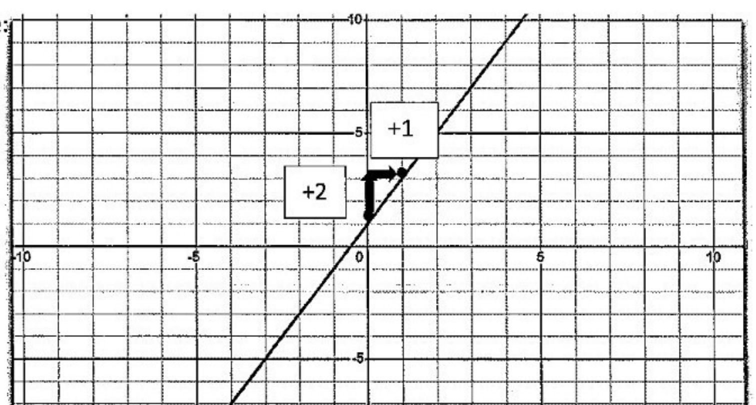
Stage 3: Finding the Slope from a Graph

The previous stage focused on finding the slope between two points. This stage focuses on finding the slope from a graph. There are two ways to accomplish this, first find two points on the graph and follow the procedure from the last center. The second option is to use the formula below.

$$Slope = \frac{\Delta Y}{\Delta X} = \frac{Rise\ (vertical)}{Run\ (horizontal)}$$

Rise is the vertical distance the line goes to go from point to point. If the line goes up, this is a positive direction and therefore the rise would be positive. If the line goes down, then this is negative direction and therefore the rise is negative. The run is the horizontal distance to go from point to point. If the line goes right, this is a positive direction and therefore the run would be positive. If the line goes left, this is a negative direction and therefore the run is negative. (Think of a coordinate plane and where the positive and negative numbers are located). Always do the run before the rise and write the rise and run as a fraction. Below is an example of finding the slope from a graph using Desmos. Read through the example and then complete the tries. Once you have completed the tries have the teacher check them.

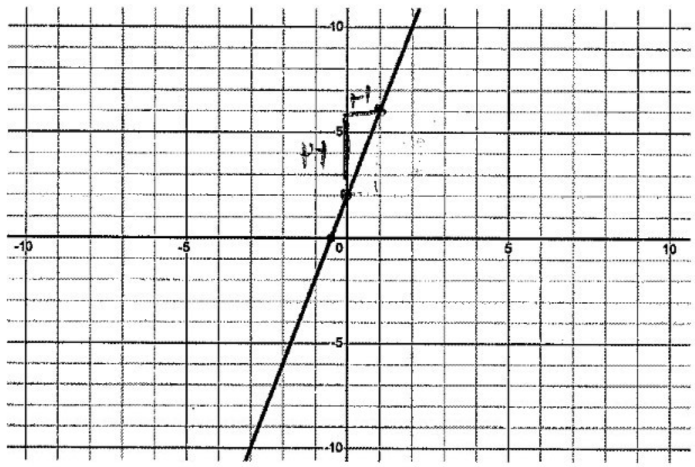
Example:



The first step is to find two points that are directly on crossing lines. Two points are marked on the graph above. It does not matter what point to start with, but generally start with the point to the left and work your way to right point. The rise is going up and goes up two. Therefore, the rise is +2. The run is going right and goes one unit. Therefore, the run is +1. Once simplified, the slope is 2.

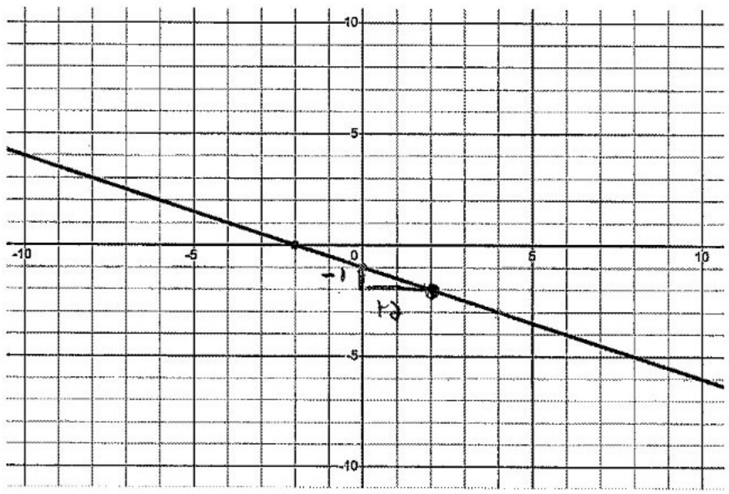
$$Slope = \frac{\Delta Y}{\Delta X} = \frac{Rise}{Run} = \frac{+2}{+1} = 2$$

Try: Find the slope of the line below:



$\frac{\Delta y}{\Delta x} = \frac{4}{1} = 4$

Try: Find the slope of the line below:



$\frac{\Delta y}{\Delta x} = \frac{-1}{2}$

Algebra
Stage 4: Translating Slope into Words

Name: Key Date: ______________

Stage 4: Translating Slope into Words

The previous stages focused on finding slope. This stage will focus on what that slope means. More importantly what that slope means in terms of graphing slope. This will be needed for tomorrow's lesson. To help organize slope it is important to use the first part of the formulas we have used.

$$Slope = \frac{\Delta Y}{\Delta X}$$

The top number represents the change in the y direction. Therefore, if the slope is negative, then the line will move down. The bottom number represents the x direction. If the slope is not a fraction, remember that a one can be placed under whole number to make it a fraction. It is also important to remember there are two options for translating slope into words. The other translation is always the opposite directions for both parts of slopes. This will be important for graphing slope tomorrow. Below is an example of translating slope into words. Read through the example, and then complete the tries. Once completed, have the teacher check them.

Example: Translate the following slope into words: $\frac{-3}{4}$

$$Slope = \frac{\Delta Y}{\Delta X} = \frac{-3}{4} = \frac{Down\ 3}{Right\ 4} = \frac{3}{-4} = \frac{Up\ 3}{Left\ 4}$$

The first translation is down 3 and right 4. This is using the direct slope given and the directions. The second translation is up 3 and left 4. This is found by doing the opposite of both directions.

Try: Translate the following slope into words: $\frac{2}{5}$

$\frac{\Delta Y}{\Delta X} = \frac{2}{5}$ $\frac{\text{Up } 2}{\text{right } 5}$ or $\frac{\Delta Y}{\Delta X} = \frac{-2}{-5}$ $\frac{\text{Down } 2}{\text{Left } 5}$

Try: Translate the following slope into words: -4

$\frac{\Delta Y}{\Delta x} = \frac{-4}{1}$ $\frac{\text{Down } 4}{\text{Right } 1}$ or $\frac{\Delta Y}{\Delta x} = \frac{4}{-1}$ $\frac{\text{Up } 4}{\text{Left } 1}$

Algebra
Exit Ticket for Slope Lesson

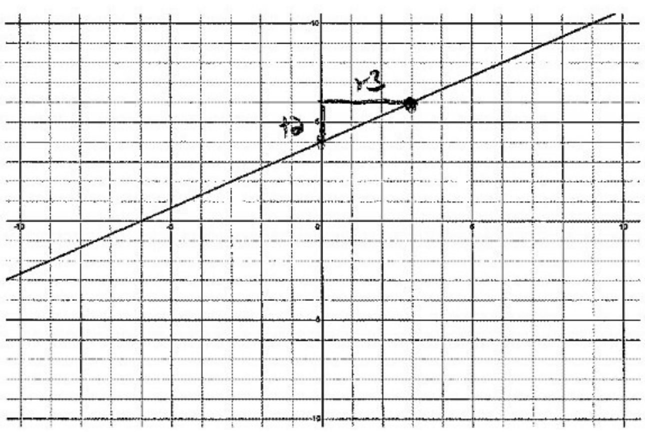
Name: Key　　　　　　　　　　　　　　　　Date: ____________

Below are three different scenarios for slope. Which of the following has the largest slope?

1) The slope between (1, 5) and (-4, -2).
$x_1\ y_1 \qquad x_2\ y_2$

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2-5}{-4-1} = \frac{-7}{-5} = \frac{7}{5}$$

2) The slope of this line:



$$\frac{\Delta Y}{\Delta x} = \frac{2}{3}$$

3) The average rate of change for the following scenario: In 1996 there was a population of 2426 hamsters in New York. In 2020, there was a population of 3218 hamsters in New York.

(1996, 2426) (2020, 3218)
$x_1\ \ y_1 \qquad x_2\ \ y_2$

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3218 - 2426}{2020 - 1996} = \frac{792}{24} = 33$$

Algebra
Warm Up

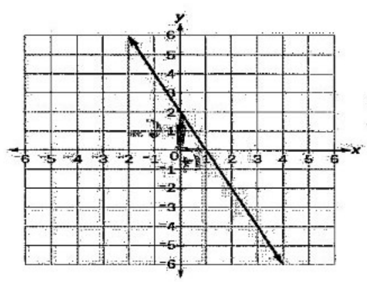
Name: ______________________________ Date: ________________

1) Find the slope (2, 3) and (-5, -4).

$x_1\ y_1 \qquad x_2\ y_2$

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4-3}{-5-2} = \frac{-7}{-7} = 1$$

2) Find the slope of the line below:



$$\frac{\Delta y}{\Delta x} = \frac{-2}{1} = -2$$

Algebra
Stage 1: Slope-Intercept Form

Name: Key Date: ____________

Stage 1: Slope-Intercept Form

Yesterday we worked on finding the slope of lines. Today we want to work on giving the lines names. The way we give lines names is by writing the equation of a line in terms of its slope and y-intercept. Every line is unique to its slope and y-intercept. Therefore, an equation that uses these two attributes will be unique and have its own unique name. Below is the general form of the slope intercept form, along with what the variables represent.

$$y = mx + b$$

(x, y) represent a point on the line. These could be any of the infinite amount of points that make up the line. Because of this, when we write the equation, we generally leave the x and y as variables.

m represents the slope of the line. This is always positioned in front of the x.

b represents the y-coordinate of the y-intercept. This is always being added or subtracted from the term with the x.

Now that you have seen slope-intercept form, it is important to be able to pick out the pieces of an equation already in slope intercept form. Below is an example, read through the example and then work through the try problems. Once completed have the teacher check your answers.

Example: What is the slope and y-intercept of the following equation?

$$y = 3 + \frac{-2}{5}x$$

The slope of the equation is $\frac{-2}{5}$. This can be determined by the place of the slope, which is always in front of the x. As long as the equation is in the form "y =", and the other side is simplified, you will be able to pick out the slope by the coefficient on the x. The y-intercept is (0, 3). This is always the term being added or subtracted to or from the x term. Remember to write you y-intercept as a point. The y-intercept always has a x-coordinate of 0.

Try: What is the slope and y-intercept of the following equation?

$$y = \underset{\uparrow \atop m}{2x} + \underset{\uparrow \atop b}{5}$$

Slope = 2
y-intercept = (0, 5)

Try: What is the slope and y-intercept of the following equation?

$$\underset{\uparrow \atop b}{-4} \underset{\uparrow \atop m}{-\, x} = y$$

Slope = -1
y-intercept = (0, -4)

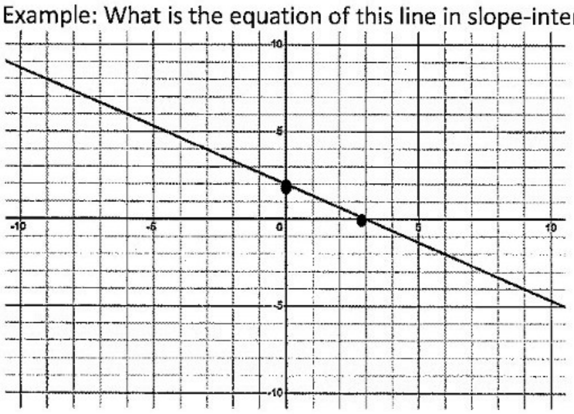
Algebra
Stage 2: Writing Slope-Intercept from a Graph

Name: Key Date: ______________

Stage 2: Writing Slope-Intercept from a Graph

Slope-Intercept form of the equation of a line is a handy tool for mathematicians. Being able to write the equation from a graph is a task, that requires you to be able to find the slope of a line from a graph and the y-intercept. Finding the slope from a graph reviews yesterday's topic (refer to yesterday's work if you need help). To pick out the y-intercept, you need to find where the line crosses the y-axis. An example is below. Read through the example and do the try problems. Once complete have the teacher check your answers.

Example: What is the equation of this line in slope-intercept form?

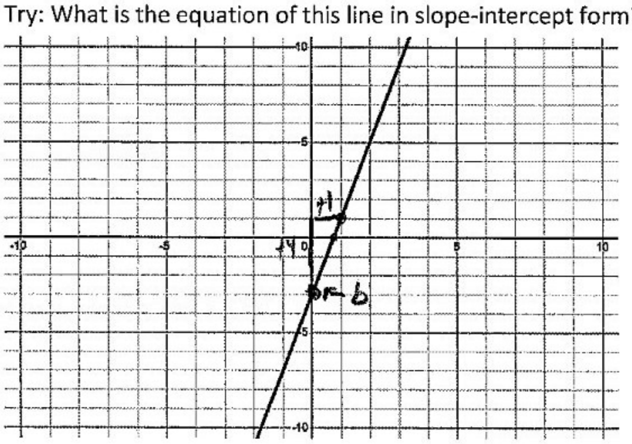


The first part is to find the slope, the graph has marked two nice points. Find the slope between these two points. Reference yesterday's lesson. The y-intercept is the point marked on the graph, where the line crosses the y-axis.

$Slope = \frac{-2}{3}$ $\quad y - intercept = (0, 2)$

$y = \frac{-2}{3}x + 2$

Try: What is the equation of this line in slope-intercept form?



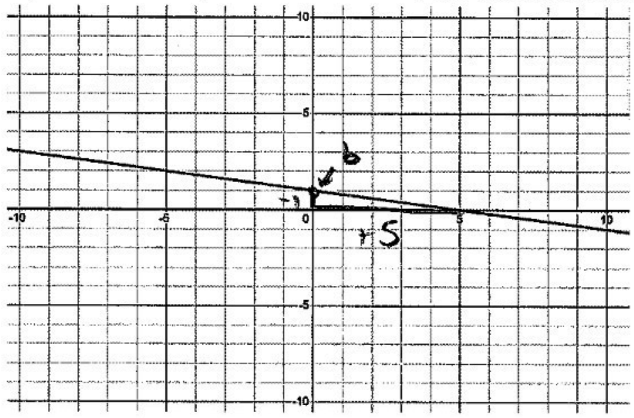
$m = \frac{\Delta y}{\Delta x} = \frac{4}{1} = 4$

$b = -3$

$y = mx + b$

$y = 4x - 3$

Try: What is the equation of this line in slope-intercept form?



$m = \frac{\Delta y}{\Delta x} = \frac{1}{5}$

$b = 1$

$y = mx + b$

$y = \frac{1}{5}x + 1$

Algebra
Stage 3: Slope-Intercept from Two Points

Name: Key Date: ______________

Stage 3: Slope-Intercept from Two Points

In this stage, there will only be two points given. Using these two points, you can write the equation of the line in slope-intercept form. The first step is to find the slope between the two points. This is from yesterday's lesson and feel free to reference those notes from yesterday. After finding the slope, plug the slope into m, and use either of the two points to substitute into x and y. After substitution, the equation will only have one variable left, b. Solve for b and that is the y-intercept. The final step is to write the equation with only the slope and y-intercept as numbers. X and y will remain x and y. Example is included below. Read through this example and then do the try problems. Once completed, have the teacher check your answers.

Example: Find the equation of a line that goes through (4, 5) and (-8, -4) in slope-intercept form.

$$Slope = \frac{\Delta Y}{\Delta X} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4-5}{-8-4} = \frac{-9}{-12} = \frac{3}{4}$$

Find the slope first, using the slope formula. Remember to simplify your slope.

$$y = mx + b \rightarrow 5 = \frac{3}{4}(4) + b$$

Substitute a point into x and y. It does not matter which point, I picked (4, 5) because they were positive values. Make sure you put the x-coordinate in for x and the y-coordinate in for y.

$$5 = 3 + b$$

$\frac{3}{4}(4) = 3$ use your calculator if you need help with the fractions.

$$\begin{aligned} 5 &= 3 + b \\ -3 &\ \ -3 \\ 2 &= b \end{aligned}$$

Subtract three from both sides to solve for b. Final step is to write your equations.

$$y = \frac{3}{4}x + 2$$

$x_1\ y_1 \quad x_2\ y_2$

Try: Find the equation of a line that goes through (-3, 5) and (0, -4) in slope-intercept form.

$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4-5}{0-(-3)} = \frac{-9}{3} = -3$

$y = mx + b$ ← y-intercept

$y = -3x - 4$

Try: Find the equation of a line that goes through (3, 4) and (-6, 7) in slope-intercept form.

$x_1\ y_1 \quad x_2\ y_2$

$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7-4}{-6-3} = \frac{3}{-9} = \frac{-1}{3}$

$y = mx + b$

$4 = -\frac{1}{3}(3) + b$

$4 = -1 + b$

$+1 \quad +1$

$5 = b$

$y = \frac{-1}{3}x + 5$

Try: Find the equation of a line that goes through (-6, -9) and (-2, -7) in slope-intercept form.

$x_1\ y_1 \quad x_2\ y_2$

$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-7-(-9)}{-2-(-6)} = \frac{2}{4} = \frac{1}{2}$

$y = mx + b$

$-7 = \frac{1}{2}(-2) + b$

$-7 = -1 + b$

$+1 \quad +1$

$-6 = b$

$y = \frac{1}{2}x - 6$

Algebra
Stage 4: Graphing from Slope-Intercept Form

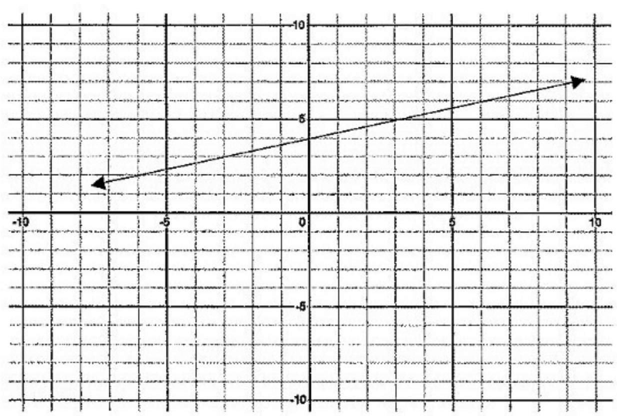
Name: Key Date: ____________

Stage 4: Graphing from Slope-Intercept Form

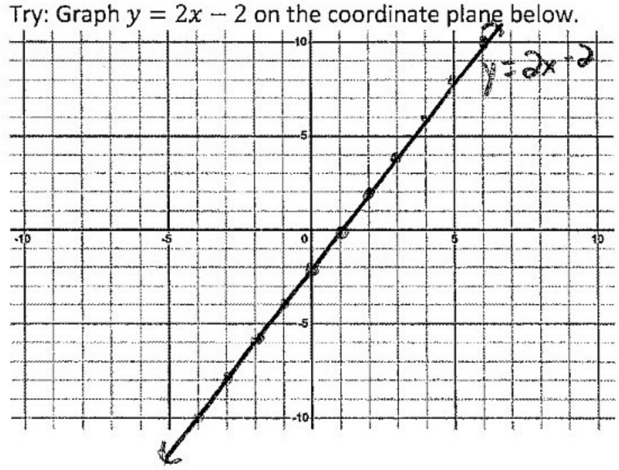
In this final stage, we will use slope-intercept to graph lines. This is basically the opposite of stage 2. Using stage 1, we will pick out the slope and y-intercept from the equation. First graph the y-intercept. Remember this is where the line crosses the y-axis. Then using the slope, we will graph points until we have no more room to graph. You will need to remember yesterday's lesson on what slope means in words. Feel free to reference the notes from yesterday. An example is below. After reading through the example, do the try problems and have the teacher check them.

Example: Graph $y = \frac{1}{3}x + 4$ on the coordinate plane.

The first step is to pick out the slope and y-intercept. The slope is $\frac{1}{3}$ and the y-intercept is (0, 4). Graph (0, 4) first. After graphing the point, remember that a slope of $\frac{1}{3}$ means up one and right three. Or the other translation is down one, left three. Graph until there is no more space on the graph. Connect the points with a line. Draw arrowheads and label the line with its equation.



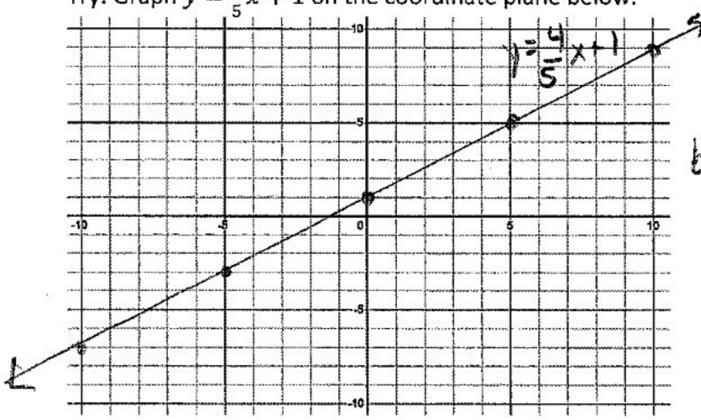
Try: Graph $y = 2x - 2$ on the coordinate plane below.



$m = 2 \rightarrow \frac{\text{up } 2}{\text{right } 1}$

$b = -2$

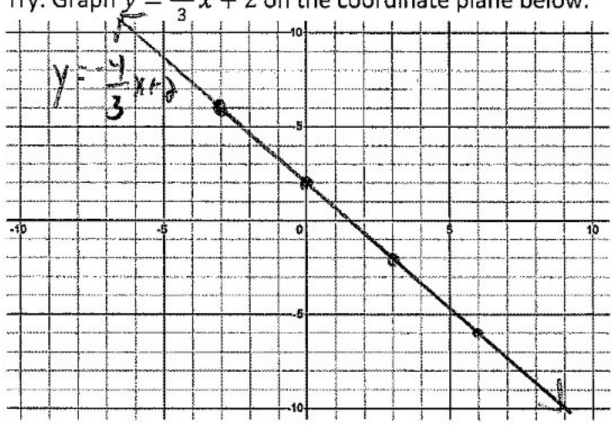
Try: Graph $y = \frac{4}{5}x + 1$ on the coordinate plane below.



$m = \frac{4}{5}$ $\frac{\text{up } 4}{\text{right } 5}$

$b = 1$

Try: Graph $y = \frac{-4}{3}x + 2$ on the coordinate plane below.



$m = -\frac{4}{3}$ $\frac{\text{Down } 4}{\text{right } 3}$

$b = 2$

Algebra
Exit Ticket for Slope Intercept

Name: Key Date: ______________

On a nice day, you decide to walk home from school. You will walk at a constant rate. After 20 minutes, you are 2 miles from home. After 40 minutes, you are 1 mile from home.

1) Write two points with x being the time walking and y being miles from home.

(20, 2) (40, 1)

2) Write the equation of the line that goes between the two points. (Challenge: what does the y-intercept represent in the problem?)

$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1-2}{40-20} = \frac{-1}{20}$

$y = mx + b$

$1 = \frac{-1}{20}(40) + b$

$1 = -2 + b$

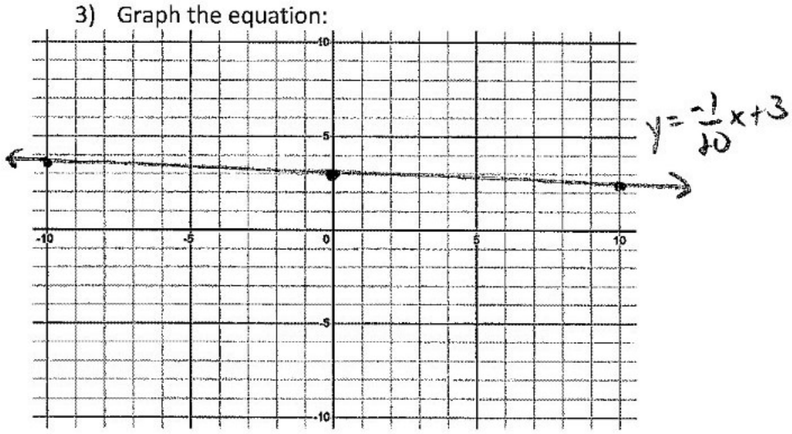
$+2 \quad +2$

$3 = b$

$y = \frac{-1}{20}x + 3$

How many miles you started from home

3) Graph the equation:



Algebra
Warm Up

Name: Key Date: ________________

1) Find the equation of the line that goes through (0, 2) and (1, 5).

x_1 y_1 x_2 y_2

y-intercept

$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5-2}{1-0} = \frac{3}{1} = 3$

$y = 3x + 2$

Algebra
Stage 1: Point-Slope Form

Name: ______________________________ Date: _______________

Stage 1: Point-Slope Form

Yesterday we worked on finding the slope-intercept equation of lines. These equations were a way to give the lines name. Today we will cover a second way to give these equations names. The way we give lines names is by writing the equation of a line in terms of its slope and a single point on the line. Below is the general form of the point-slope form, along with what the variables represent.

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

(x, y) represent any point on the line. These could be any of the infinite amount of points that make up the line. Much like yesterday, when we write the equation we will leave these as x and y.

m represents the slope of the line. This is always positioned in front of the x.

(x_1, y_1) represent a single point on the line. This point can be picked at random. Unlike the x and y, you will need to have numbers in your equation. Also, be careful of negative values, to write the simplified equation you will need to rewrite double negatives as addition.

Now that you have seen point-slope form, it is important to be able to pick out the pieces of an equation already in point-slope form. Below is an example, read through the example and then work through the try problems. Once completed have the teacher check your answers.

Example: What is the slope and a point of the following equation?

$$y + 2 = 3(x - 4)$$

The slope of the equation is 3. This can be determined by the place of the slope, which is always in front of the x. The point included is (4, -2). This is always the opposite of what is being added or subtracted from the x and y. The x-coordinate goes with the x and the y-coordinate goes with the y.

Try: What is the slope and a point of the following equation?

$$y + 1 = \underset{\substack{\uparrow \\ m}}{2}(x + 5)$$

Slope = 2
point (-5, -1)

Try: What is the slope and a point of the following equation?

$$y - 2 = \underset{\substack{\uparrow \\ m}}{\frac{-2}{5}}(x - 4)$$

Slope: $\frac{-2}{5}$
point: (4, 2)

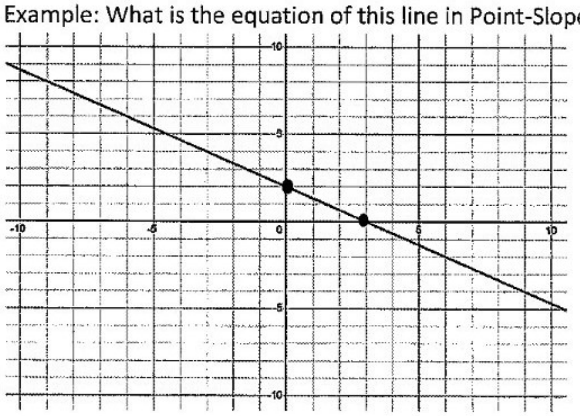
Algebra
Stage 2: Writing Point-Slope from a Graph

Name: key Date: ______________

Stage 2: Writing Point-Slope from a Graph

Point-slope form of the equation of a line is a handy tool for mathematicians. Being able to write the equation from a graph is a task, that requires you to be able to find the slope of a line from a graph and the point referenced in the equation. Finding the slope from a graph reviews slope. To pick out the point, you need to find any point on the line. Pick a point, that is perfect and on two crossing lines. An example is below. Read through the example and do the try problems. Once complete have the teacher check your answers.

Example: What is the equation of this line in Point-Slope form?



The first part is to find the slope, the graph has marked two nice points. Find the slope between these two points. Reference the lesson from two days ago.

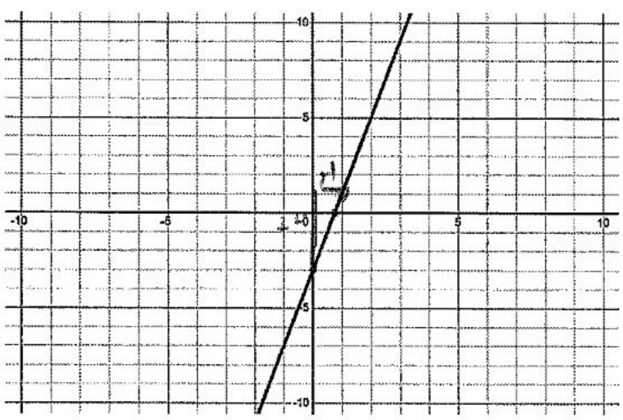
$Slope = \frac{-2}{3}$ $\quad$ $Point\ Options: (0, 2), (6, -2)$

$y—(-2) = \frac{-2}{3}(x - 6)$

$y + 2 = \frac{-2}{3}(x - 6)$

There are many different options for this equation. It all depends on the point picked. Just remember to simplify double negatives.

Try: What is the equation of this line in point-slope form?



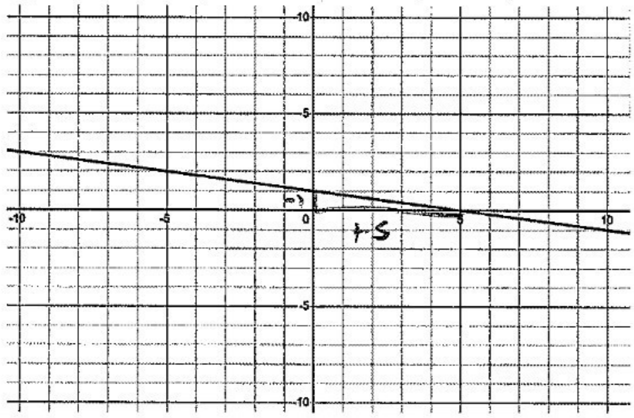
$m = \frac{4}{1} = 4$

Points: $(0, -3)$ $(1, 1)$ $(2, 5)$

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

$y - 1 = 4(x - 1)$ etc.

Try: What is the equation of this line in point-slope form?



$m = \frac{-1}{5}$

points: (0, 1) (5, 0) (-5, 2)

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

$y - 2 = \frac{-1}{5}(x - (-5))$

$y - 2 = \frac{-1}{5}(x + 5)$

Algebra
Stage 3: Point-Slope from Two Points

Name: Key Date: ____________

Stage 3: Point-Slope from Two Points

In this stage, there will only be two points given. Using these two points, you can write the equation of the line in slope-intercept form. The first step is to find the slope between the two points. This is from the slope lesson and feel free to reference those notes. After finding the slope, plug the slope into m, and use either of the two points to substitute into x_1 and y_1. After substitution, the equation will be complete. The final step is to simplify double negatives, by making them addition. It does not matter which point you use. Example is included below. Read through this example and then do the try problems. Once completed, have the teacher check your answers.

Example: Find the equation of a line that goes through (4, 5) and (-8, -4) in point-slope form.

$$Slope = \frac{\Delta Y}{\Delta X} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4-5}{-8-4} = \frac{-9}{-12} = \frac{3}{4}$$

Find the slope first, using the slope formula. Remember to simplify your slope.

$$y - y_1 = m(x - x_1) \rightarrow y - 5 = \frac{3}{4}(x - 4)$$

OR

$$y - y_1 = m(x - x_1) \rightarrow y - (-4) = \frac{3}{4}(x - (-8))$$

$$y + 4 = \frac{3}{4}(x + 8)$$

Substitute a point into x_1 and y_1. It does not matter which point, I picked (4, 5) first because they were positive values. Make sure you put the x-coordinate in for x_1 and the y-coordinate in for y_1.

Try: Find the equation of a line that goes through (-3, 5) and (0, -4) in point-slope form.

$x_1\ y_1$ $x_2\ y_2$

$$\frac{\Delta Y}{\Delta X} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4-5}{0-(-3)} = \frac{-9}{-3} = 3$$

$y - y_1 = m(x - x_1)$
$y - 5 = 3(x - (-3))$
$y - 5 = 3(x + 3)$

or

$y - (-4) = 3(x + 0)$
$y + 4 = 3(x + 0)$

Try: Find the equation of a line that goes through (3, 4) and (-6, 7) in point-slope form.
$x_1\ y_1 \quad x_2\ y_2$

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7-4}{-6-3} = \frac{3}{-9} = \frac{-1}{3}$$

$$y - y_1 = m(x - x_1)$$
$$y - 4 = \frac{-1}{3}(x-3)$$
or
$$y - 7 = \frac{-1}{3}(x-(-6))$$
$$y - 7 = \frac{-1}{3}(x+6)$$

Try: Find the equation of a line that goes through (-6, -9) and (-2, -7) in point-slope form.
$x_1\ y_1 \quad x_2\ y_2$

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-7-(-9)}{-2-(-6)} = \frac{2}{4} = \frac{1}{2}$$

$$y - y_1 = m(x - x_1)$$
$$y - (-9) = \frac{1}{2}(x-(-6))$$
$$y + 9 = \frac{1}{2}(x+6)$$
or
$$y - (-7) = \frac{1}{2}(x-(-2))$$
$$y + 7 = \frac{1}{2}(x+2)$$

Algebra
Stage 4: Graphing from Point-Slope Form

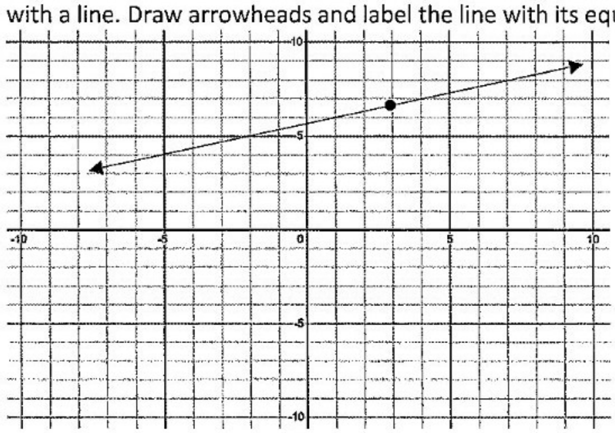
Name: Key   Date: ____________

Stage 4: Graphing from Point-Slope Form

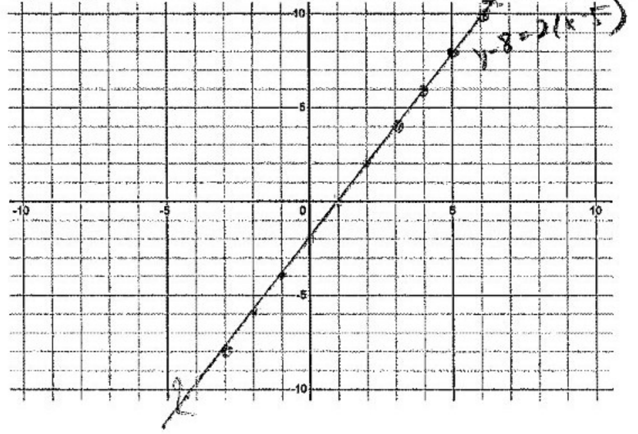
In this final stage, we will use point-slope to graph lines. This is basically the opposite of stage 2. Using stage 1, we will pick out the slope and a point from the equation. First graph the point. Remember the coordinates will be the opposite of addition and subtraction. Then using the slope, we will graph points from the graphed point until we have no more room to graph. You will need to remember the slope lesson on what slope means in words. Feel free to reference the notes. An example is below. After reading through the example, do the try problems and have the teacher check them.

Example: Graph $y - 5 = \frac{1}{3}(x - 3)$ on the coordinate plane.

The first step is to pick out the slope and the point. The slope is $\frac{1}{3}$ and the point is (3, 5). Graph (3, 5) first. After graphing the point, remember that a slope of $\frac{1}{3}$ means up one and right three. Or the other translation is down one, left three. Graph until there is no more space on the graph. Connect the points with a line. Draw arrowheads and label the line with its equation.

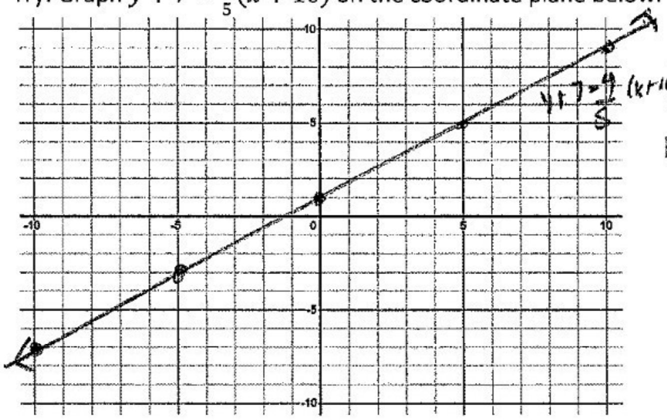


Try: Graph $y - 8 = 2(x - 5)$ on the coordinate plane below.



$m = 2$
point $(5, 8)$

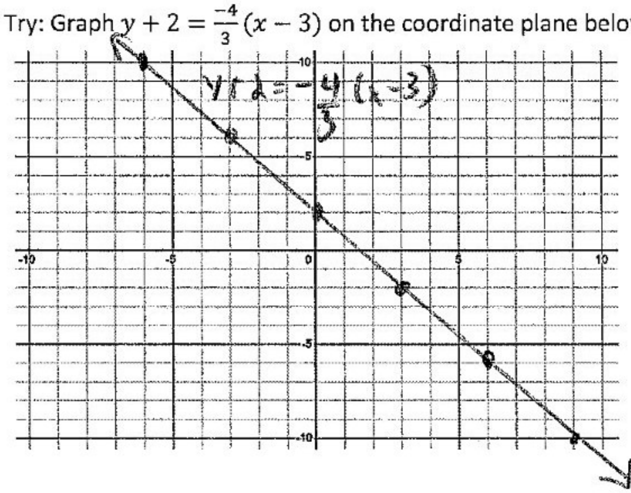
Try: Graph $y + 7 = \frac{4}{5}(x + 10)$ on the coordinate plane below.



$m = \frac{4}{5}$

point $(-10, -7)$

Try: Graph $y + 2 = \frac{-4}{3}(x - 3)$ on the coordinate plane below.



$m = \frac{-4}{3}$

point $(3, -2)$

Algebra
Stage 5: Point-Slope to Slope-Intercept

Name: Key   Date: ______________

Stage 5: Point-Slope to Slope-Intercept

This lesson has one final stage, and that is being able to take point-slope and write it in slope-intercept form. The reason we need to be able to do this, is because having the y-intercept is important in many real-world applications. Instead of completing all the work needed to get a second equation, we can just take point-slope and put it into slope-intercept form. First it is important to look at the two equations to notice the difference.

$$y = mx + b$$
$$y - y_1 = m(x - x_1)$$

The major difference in the equations is that slope-intercept has the y on a side all by itself. Slope-intercept also does not have any parenthesis. So if we take point-slope and get rid of the parenthesis (by the distributive property) and get the y on a side by itself, it will be in slope-intercept form. Below is an example of how to do this. Read through the example and then do the try problems. Once completed have the teacher check your answers.

Example: What is $y + 5 = \frac{1}{2}(x - 4)$ in slope-intercept form?

$$y + 5 = \frac{1}{2}(x - 4)$$

Distribute the slope first.

$$y + 5 = \frac{1}{2}x - \frac{1}{2}(4)$$
$$y + 5 = \frac{1}{2}x - 2$$

Solve for y, by subtracting five from both sides.

$$y + 5 - 5 = \frac{1}{2}x - 2 - 5$$
$$y = \frac{1}{2}x - 7$$

Try: What is $y - 1 = \frac{-2}{3}(x + 7)$ in slope-intercept form?

$$y - 1 = \frac{-2}{3}x - \frac{14}{3}$$
$$+1 \qquad\qquad +1$$
$$y = \frac{-2}{3}x - \frac{11}{3}$$

Try: What is $y - 8 = 7(x + 9)$ in slope-intercept form?

$$y - 8 = 7x + 63$$
$$+8 \qquad\qquad +8$$
$$y = 7x + 71$$

Algebra
Exit Ticket for Point Slope

Name: Key

Date: ______________

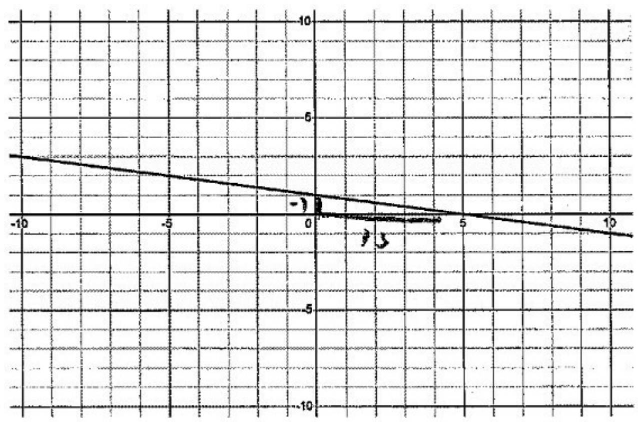
Two linear functions are below. One of the functions will be the answer to each question.

$y - 5 = 3(x + 2)$

$m = 3$

$y - 5 = 3x + 6$
$+5 \quad\quad +5$

$y = 3x + 11$



$m = \frac{-1}{5}$

Point $(-5, 2)$

1) Which function has a negative slope?
Graph

2) Which function goes through (-2, 5)?
Equation

3) Which function has an equation of $y = 3x + 11$?
Equation

4) What is the point-slope formula of the graphed function?

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

$y - 2 = \frac{-1}{5}(x - (-5))$

$y - 2 = \frac{-1}{5}(x + 5)$

Algebra
Activity on Linear Modeling

Name: Key Date: ______________

Before we start the activity let's go over some important questions.

1) What is a linear function?
A function that graphs a line or has a degree of one.
2) How do you find the average rate of change?
Slope
3) What is the general form of slope intercept form? What do the variables mean?
$y=mx+b$ $m=$ slope
$b=$ y-intercept
4) What is an independent variable? What is a dependent variable? Which variables in slope intercept form, might represent both of those variables?
Independent Variable - input (x)
Dependent variable = output (y)

Background:

Tik Tok is a Social Media platform that allows users to express themselves musically through short videos. The videos can include dancing, singing or playing musical instruments. It has grown in popularity over the past couple years.

The Next Page will include a table of famous Tik Tokers. We will be referencing this page for our activity.

Table 1: Famous Tik Tokers Information

Name	Followers (Millions)	Likes (Millions)	Time (Months)	Type	Net Worth (Millions of Dolars)
Charli D'Amelio	107	8418	20	Dancer/Social Media Personality	8
Lil' Huddy	29	1529	10	Social Media Personality	0.5
Dixie D'Amelio	48	2795	13	Singer, Actress, Social Media Personality	3

4) Which of those columns would be a good choice for dependent variable? Or which would you be most interested in looking at?

Followers, Likes, Net worth

5) Now that we have an independent and dependent variable, let's write some points so that we can find the Average Rate of Change. We need at least two points.

(0,0) Ex!) Charli D'Amelio's Followers (20,107)

6) What is the average rate of change between the two points?

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{107-0}{20-0} = \frac{107}{20}$$

7) What is the y-intercept of the equation?

(0,0)

8) What would be the equation we came up with?

$$y = \frac{107}{20}x$$

Part II

Let's look at Loren Grey's change in followers.

1) If we use time on Tik Tok (in months) as our independent variable and followers as our dependent variable. What are two points we can write for Loren Gray?

(72,51) (62,41)

2) What is the average rate of change in followers for Loren Gray?

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{41-51}{62-72} = \frac{-10}{-10} = 1$$

3) What would be the y-intercept for Loren Gray followers? What does the y-intercept represent in the problem?

$y = mx + b$

$51 = 1(72) + b$

$51 = 72 + b$

$-72 \quad -72$

$-19 = b$

This means Loren Gray started with -19 million fans.

4) Write a linear equation to represent Loren Gray's followers over time.

$y = 1x - 19$

5) Why is this equation unrealistic?

You can not start with negative followers.

6) Let's assume it is correct for a short time interval. How many followers would Loren Gray have after 60 months?

$y = 1(60) - 19$
$y = 60 - 19$
$y = 41$

Loren Gray would have 41 million followers after 60 months.

7) How long would it take for Loren Gray to a 100 million fans?

$100 = 1x - 19$
$+19 \quad +19$
$119 = 1x$

It would take 119 months for Loren Gray to have 100 million fans.

In Conclusion:

- If we are given two points we can write a linear equation to represent the scenario:
  - True or False
- Linear equations are good representations for all types of data:
  - True or False
- I need to know the independent and dependent variable in a word problem before I can find the average rate of change:
  - True or False
- After writing a linear equation, I can find an output or input with ease:
  - True or False
- Rate the following on a scale of 1 being no confidence and 5 being Extremely confident
  - I can find the average rate of change: _______________
  - I can write an equation of linear scenario: _______________
  - I can use that equation to solve for other inputs or outputs: _______________

Algebra Exit Ticket on Linear Modeling

Name: Key Date: ______________

Below is a chart for Baby Ariel followers on Tik Tok verse her time on Tik Tok. Use the information in the chart to answer the questions.

Months on Tik Tok (x)	Number of Followers (in Millions) (y)
24	19
68	35

(24, 19) (68, 35)

1) What is the average rate of change of the number of followers?

$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{35-19}{68-24} = \frac{16}{44} = \frac{4}{11}$

2) What is a linear equation that we could use to represent the change in followers for Baby Ariel?

$y = mx + b$

$19 = \frac{4}{11}(24) + b$

$19 = \frac{96}{11} + b$

$-\frac{96}{11} \quad -\frac{96}{11}$

$b = \frac{113}{11}$

$y = \frac{4}{11}x + \frac{113}{11}$

3) Is this a realistic equation? Why or Why not?

No, because everyone would start with a y-intercept of zero.

4) Using the equation, how many followers would Baby Ariel have after a year?

$y = \frac{4}{11}(12) + \frac{113}{11} = \frac{48}{11} + \frac{113}{11} = \frac{161}{11}$ million

5) How long would it take for Baby Ariel to have 50 million followers?

$50 = \frac{4}{11}x + \frac{113}{11}$

$-\frac{113}{11} \quad -\frac{113}{11}$

$\left(\frac{11}{4}\right)\frac{437}{11} = \left(\frac{4}{11}x\right)\frac{11}{4}$

$x = \frac{437}{11}$ months

Addison Rae	75	4732	18	Dancer/Social Media Personality	2
Noah Beck	24	1447	12	Social Media Personality	0.5
Josh Richards	24	1524	73	Social Media Personality	1.5
Zach King	55	662	59	Film Maker, Social Media Personality	3
Baby Ariel	35	1881	69	Singer, Actress, Social Media Personality	6
Avani Gregg	31	2167	14	Social Media Personality	20
Loren Gray	51	2712	72	Singer, Dancer, Social Media Personality	10

Table 2: Famous Tik Tokers Surpassed in Followers

Name	Numbers of Followers (In Millions)	Date Surpassed	Months on Tik Tok when surpassed	Who Surpassed them
Baby Ariel	19	April 2017	24	Lisa and Lena
Loren Gray	41	March 2020	62	Charli D'Amelio

1) Pick your favorite Tik Toker of the 10 on the list and write down what you enjoy about them. Maybe describe your favorite Tik Tok that they made. If you do not use Tik Tok, come up with a question or two you would you be interested in asking a top Tik Tok star?

   Etc

2) If we think about the starting process of becoming a star on Tik Tok, how many followers would someone start with? What might this represent when we think about a linear equation (think about y = mx + b)

   Zero followers, would represent b

3) Which of those columns listed above might be the best choice for the independent variable?

   Time