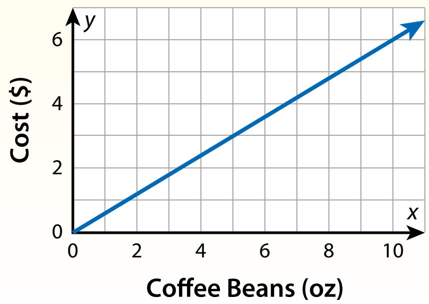
LESSON 8

Graph Proportional Relationships and Define Slope

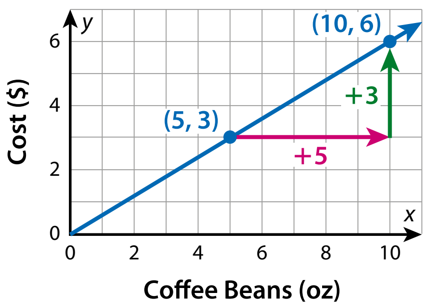
Dear Family,

This week your student is learning about slope. Students have learned previously about proportional relationships and unit rate. The graph of a proportional relationship is a line. When talking about a line, the unit rate is called the **slope**. Slope can be found by taking two points on the line and dividing the vertical change by the horizontal change. Students will learn to solve problems like the one below.

A local coffeeshop sells coffee beans by weight. The graph shows the relationship between weight in ounces and cost. Find the slope of the line. How much does 1 ounce of coffee beans cost?



➤ **ONE WAY** to find the slope of a line is to divide the vertical change by the horizontal change between two points on the line.



$3 \div 5 = 0.6$

➤ **ANOTHER WAY** to find the slope of a line is to choose two points on the line and use the slope formula,

$$\text{slope} = \frac{\text{change in } y\text{-coordinates}}{\text{change in } x\text{-coordinates}} \text{ or}$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}.$$

Choose points (0, 0) and (5, 3).

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 0}{5 - 0} = \frac{3}{5}$$

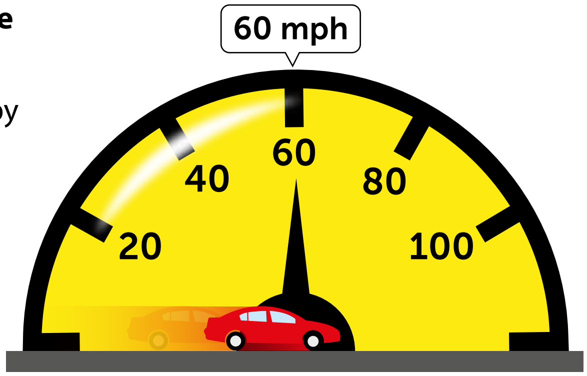
Using either method, the slope is $\frac{3}{5}$, or 0.6. One ounce of coffee beans costs \$0.60.

Use the next page to start a conversation about slope.

Activity Thinking About Slope

➤ **Do this activity together to investigate slope in the real world.**

When a proportional relationship is modeled by a straight line, the unit rate is the same as the slope of the line. For example, when someone drives at a rate of 60 miles per hour on the highway, the unit rate of this proportional relationship is 60. The slope of the line modeling this relationship is also 60.



? Where else do you see examples of unit rate and slope in the world around you?

LESSON 9

Dear Family,

This week your student is learning about equations of lines and their graphs. Students will learn that a **linear equation**, or an equation that describes a straight line, can be written in **slope-intercept form**.

The slope-intercept form of a linear equation is $y = mx + b$, where m is the slope and b is the ***y*-intercept**, or the y-coordinate of the point where the line crosses the y-axis. When $b = 0$, a linear equation is written in the form $y = mx$. Students can graph a linear equation written in slope-intercept form, like in the example below.

Graph the line for the linear equation $y = 2x + 1$.

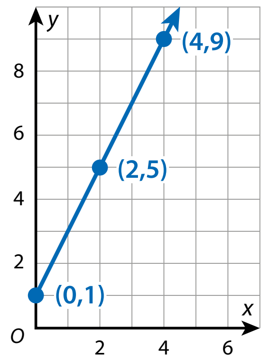
➤ **ONE WAY** to graph the line is to use the equation to find points on the line.

If $x = 0$, then $y = 2(0) + 1$, or 1.

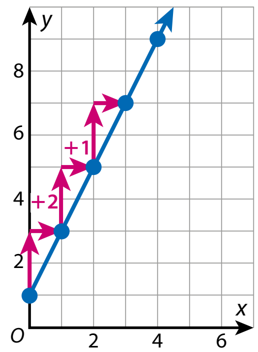
If $x = 2$, then $y = 2(2) + 1$, or 5.

If $x = 4$, then $y = 2(4) + 1$, or 9.

(0, 1), (2, 5), and (4, 9) are points on the line.



➤ **ANOTHER WAY** is to use the y-intercept and the slope to find points on the line.



The y-intercept is 1, so the point (0, 1) is on the line. The slope is 2, or $\frac{2}{1}$, so move up 2 units and right 1 unit from (0, 1) to plot the next point. You can continue moving up 2 units and right 1 unit to plot more points.

Using either method, the graph is a line with a slope of 2 and a y-intercept of 1.

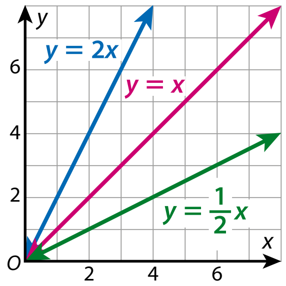
Use the next page to start a conversation about slope-intercept form.

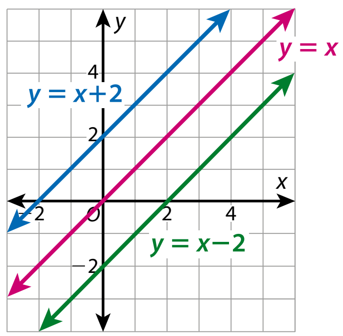
Activity Thinking About Slope-Intercept Form

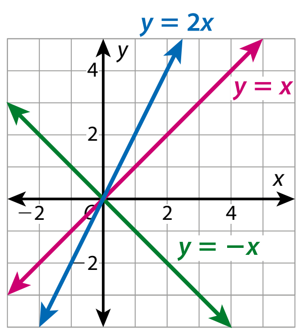
➤ **Do this activity together to investigate slope-intercept form.**

Slope-intercept form of an equation can be used to model many real-world situations that involve a starting value and a consistent change in value. Some examples include the height of a plant that grows at a constant rate and the distance covered by a car traveling at a constant speed.

? What patterns do you see between the equations written in slope-intercept form and their lines in each graph?







LESSON 11

Determine the Number of Solutions to One-Variable Equations

Dear Family,

This week your student is learning that one-variable linear equations can have one solution, infinitely many solutions, or no solution. Students will learn that an equation has:

- one solution if the equation can be written as a statement that shows a value for a variable, like $x = 2$.
- infinitely many solutions if the equation can be written as a statement that shows a true statement, like $3 = 3$ or $2x + 3 = 2x + 3$.
- no solution if the equation can be written as a statement that shows a false statement, like $2 = 3$.

Students will learn how to find the number of solutions to a linear equation, as in the problem below.

> Consider the linear equation $\frac{1}{4}(4x + 4) = x + 6$. How many solutions does the equation have?

ONE WAY to find the number of solutions is to solve the equation by first applying the distributive property.

$$\frac{1}{4}(4x + 4) = x + 6$$

$$x + 1 = x + 6 \longleftarrow \text{Distribute the } \tfrac{1}{4}.$$

$$1 = 6$$

ANOTHER WAY is to solve the equation by first eliminating the fraction.

$$4 \cdot \frac{1}{4}(4x + 4) = 4(x + 6) \longleftarrow \text{Multiply both sides by } 4.$$

$$4x + 4 = 4x + 24$$

$$4x - 4x + 4 - 4 = 4x - 4x + 24 - 4$$

$$0 = 20$$

Using either method, you get a false statement. The equation has no solution.

Use the next page to start a conversation about solutions to one-variable linear equations.

Activity Thinking About Solutions of One-Variable Linear Equations

➤ **Do this activity together to investigate solutions of one-variable linear equations.**

Solutions of a one-variable linear equation are values of x that make the equation true. There can be one value of x that makes an equation true. There can be no values of x that make an equation true. There can be infinitely many values of x that make an equation true.

? What are some patterns you notice about the number of solutions to the equations below?

EQUATION SET 1

These equations have one solution.

$4x = 8$

$x = 9$

$5x = 20$

EQUATION SET 2

These equations have no solution.

$y + 1 = y + 4$

$2y + 3 = 2y + 5$

$3y + 4 = 3y - 2$

EQUATION SET 3

These equations have infinitely many solutions.

$2z + 3 = 2z + 3$

$z - 7 = z - 7$

$3z + 12 = 3z + 12$

LESSON
12

Understand Systems of Linear Equations in Two Variables

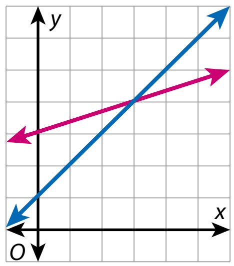
Dear Family,

This week your student is exploring **systems of linear equations**. A system of linear equations is two or more related equations that are solved together in order to find a solution common to all the equations. This solution is the (x, y) pair(s) that make all equations in the system true. On a graph, the solution is represented by the points(s) that the graphs of all the equations have in common. A system of linear equations can have one, zero, or infinitely many solutions.

Your student will first explore systems of linear equations by looking at their graphs. The following examples show the ways the graph of a system can tell you how many solutions the system has.

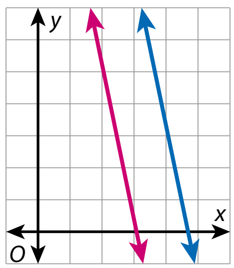
ONE WAY: One solution

The lines in this graph intersect at one point. The (x, y) pair for this point makes both equations in the system true.



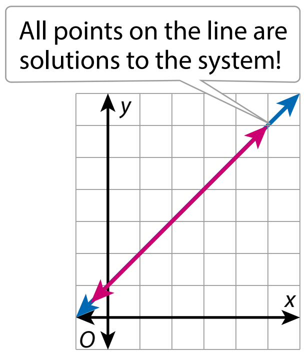
ANOTHER WAY: No solution

The lines in this graph do not intersect at all. There are no (x, y) pairs that make both equations in the system true.



ANOTHER WAY: Infinitely many solutions

The lines in this graph intersect at every point and represent the same line. The (x, y) pairs for all the points on the line make both equations in the system true.



Use the next page to start a conversation about systems of linear equations.

Activity Thinking About Systems of Linear Equations

➤ **Do this activity together to investigate systems of linear equations in the real world.**

Systems of equations help answer questions about when, or if, two relationships share the same pair of related values. For example, suppose two runners in a race are at different distances from the finish line. A system of linear equations based on their two rates of running can be used to determine if and when the runner who is behind will be able to catch up.

? Can you think of some other real-world examples where solving a system of linear equations is helpful?

LESSON 14

Represent and Solve Problems with Systems of Linear Equations

Dear Family,

This week your student is learning how to use systems of equations to solve real-world and mathematical problems. By assigning variables to real-world quantities, students will solve problems like the one below.

> Lilia volunteers at an animal shelter and a retirement community on the weekends. She spends twice as much time volunteering at the animal shelter as she does at the retirement community. She volunteers a total of 6 hours each weekend. How many hours does she spend volunteering at each location?

➤ **ONE WAY** to solve the problem is to use a table.

Let a be the time spent at the animal shelter. Let r be the time spent at the retirement community. List possible combinations of time spent at each place that give a total of 6 hours.

a	r	$2r$
1	5	10
2	4	8
3	3	6
4	2	4

If $a = 4$ and $r = 2$, then $2r = a$ and $a + r = 6$.

➤ **ANOTHER WAY** is to write and solve a system of equations.

Solve algebraically using substitution.

$2r = a$

$r + a = 6 \longrightarrow r + (2r) = 6 \longrightarrow 3r = 6 \longrightarrow r = 2$

$2r = a \longrightarrow 2(2) = a \longrightarrow 4 = a$

Using either method, you find that $r = 2$ and $a = 4$. So, Lilia spends 2 hours volunteering at the retirement community and 4 hours volunteering at the animal shelter.

Use the next page to start a conversation about solving problems with systems of linear equations.

Activity Thinking About Systems of Linear Equations

➤ **Do this activity together to investigate systems of linear equations in the real world.**

Students will learn to use systems of linear equations to represent and solve problems. Below are three real-world problems and three systems of equations. Decide which system of equations represents each problem. Draw lines to show your answers.

PROBLEM 1

Hailey is organizing a field trip. The school has small buses that can seat 16 students and large buses that can seat 32 students. There are 112 students and 4 bus drivers. How many buses of each size are required?

$x = 2y$
$x + y = 6$

PROBLEM 2

Nicanor spends \$6 on gum. Brand A costs \$1 per pack. Brand B costs \$2 per pack. Nicanor buys two more packs of brand A gum than brand B gum. How many packs of each gum does he buy?

$x + y = 4$
$16x + 32y = 112$

PROBLEM 3

It takes Francisco 6 hours to read both a book and a magazine. It takes him twice as long to read the book as the magazine. How long does it take Francisco to read each?

$x + 2y = 6$
$y + 2 = x$

? How did you match the real-world situation with the system of linear equations that represents it?

