Name:

IN THIS LESSON, YOU WILL:

- Define quantities in a word problem algebraically
- Generate standard form equations from word problems
- Graph standard form equations on the coordinate plane
- Interpret the meaning of intercepts and intersections
- Quantify financial constraints
- Evaluate trade-offs in spending and budgeting choices

INTRO

CALCULATE: Piggy Bank Math
Andre gets paid $5 a week for his allowance and $10 every time he mows his neighbor's yard. He puts all his money into his piggy bank. His piggy bank contains $70 and has only $5 bills and $10 bills.
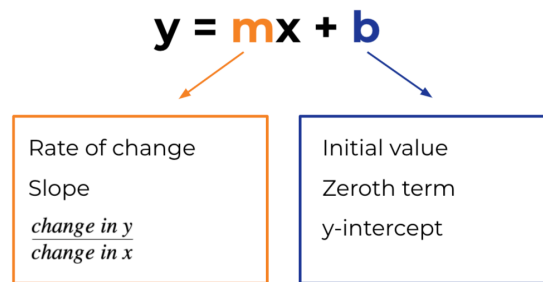Answer the following questions using any way you choose.

1. **How many $5 bills are in the piggy bank if there are no $10 bills?**

2. **How many $10 bills are there if there are no $5 bills?**

3. **Rebekah guessed that the piggy bank contained five $5 bills. Could she be right? Why or why not?**

4. **Describe in words how you would solve for the number of $10 bills if there are exactly eight $5 bills in the piggy bank.**

5. **With a partner, try to write an equation using variables that models the total value of the piggy bank based on the number of $5 bills and $10 bills inside. Use your description to help.**

Linear Equations in Standard Form

You are familiar with the slope-intercept form of a linear equation:

$$y = mx + b$$

Rate of change	Initial value
Slope	Zeroth term
$\dfrac{change\ in\ y}{change\ in\ x}$	y-intercept

In this lesson, you will learn how to write and solve equations in **standard form**. The standard form is often the easiest to directly model a real-world situation involving tradeoffs and comparisons between different items or choices. Follow your teacher's instructions to review the formula below and fill in the examples in standard form.

$$Ax + By = C$$

where:

and

x & y are variables

A, B, & C are integer constants

Equation: 3x + 5y = 30	Equation: 4x - 7y = 12	A = 4	A = 3
		B = 2	B = -2
A =	**A =**	C = 24	C = 18
B =	**B =**		
C =	**C =**	**Equation:**	**Equation:**

Writing Standard Form Equations from a Word Problem

Let's take a look back at Andre's piggy bank. We can write an equation to model this problem by following a few steps.

1. **Review the completed example problem below.**

Andre gets paid $5 a week for his allowance and $10 every time he mows his neighbor's yard. He puts all his money into his piggy bank. His piggy bank contains $70 and has only $5 bills and $10 bills.

1	**Define variables:** Assign variables to the real-world quantities in the problem	x = # of $5 bills in the piggy bank y = # of $10 bills in the piggy bank
2	**Identify A, B, and C** Match the values given in the problem to the integer constants, including the total.	Ax + By = C A = **5** because $5 bills are worth **5** dollars each B = **10** because $10 bills are worth **10** dollars each C = **70** because the total money in the bank is **70** dollars
3	**Write equation** Write the equation relating the two quantities and the total with the proper constants on each variable.	Total value of $5 bills + Total value of $10 bills = Total value of all bills $5 * # of $5 bills + $10 * # of $10 bills = Total value of all bills 5x　　　　　　　　+ 10y　　　　　　　　= 70

Now try with this second example. Use the steps to fill in the blanks.

2. **José goes to a local minor league baseball game, the Sunnydale Savers with his friends. During the 7th inning stretch, they go to the concession stand for a snack. Hot dogs are $2 and nachos are $5. They spend $20 on snacks and head back to watch the end of the game. Write an equation that models the total cost.**

1	**Define variables:**	x = y =
2	**Identify A, B, and C**	A = B = C =
3	**Write equation:**	

3. **Reflect: How did you decide which coefficient went with x and which went with y?**

PRACTICE IT

PICK 2: Writing Linear Equations in Standard Form

Pick any two of these problems. For each problem, do each of the following:

    a. Define your variables
    b. Identify A, B, and C
    c. Write the equation in standard form

Problem 1:
Jeremy sells dog collars and cat collars. The dog collars sell for $4 each and the cat collars sell for $3 each. Write an equation to model the scenario if Jeremy made $36 total.

x = _____

y = _____

A = _____   B = _____   C = _____

Equation: _____ x + _____ y = _____

Problem 2:
Sam makes bead jewelry to sell at the beach. She uses 11 beads to make a bracelet and 22 beads to make a necklace, and 33 beads to make a belt. Write an equation to model the scenario if she used 208 beads total to make just bracelets and necklaces.

Problem 3:
Betty uses 2 eggs to make brownies, 3 eggs to make a cake, and 6 eggs to make a soufflé. In all, she has one gross of eggs (that's 144 eggs). If she only makes brownies and soufflés and she uses all the eggs, write an equation to model the eggs used by Betty.

Problem 4:
Harry loves collecting things. On average, he pays $1 per postcard, $4 per figurine, and $12 per hat. Write an equation to model the total cost of his collection if he spent $88 total on just hats and figurines.

📖 **LEARN IT**

Graphing Linear Equations in Standard Form

A reminder of some terms:
- **y-intercept:** the y value when x = 0
- **x-intercept:** the x value when y = 0
- **slope:** the rate of change of y with respect to x

Standard form allows you to easily find the two points needed to make a line. These points are particularly useful as they are the y-intercept and the x-intercept for the equation.

Revisiting Andre's Piggy Bank
Taking one more look at Andre's piggy bank, we could find all the possible combinations by graphing the equation we created. Every point on the line is a combination that satisfies the specific equation we modeled.

1. **Follow the steps to graph 5x +10y= 70.**

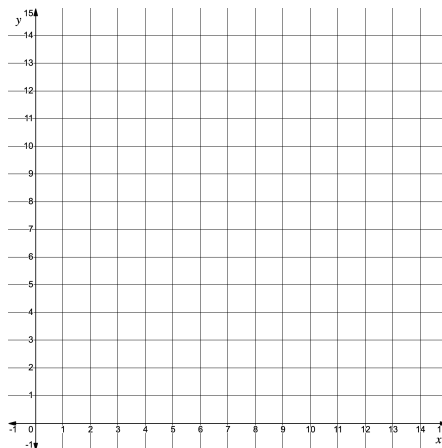|		
1	**Find the y-intercept** Set x = 0 and solve for y.	$5(0) +10y = 70$ $10y = 70$ $y = \dfrac{70}{10}$ $y = 7$ **y-intercept = (0,7)**
2	**Find the x-intercept** Set y = 0 and solve for x.	$5x + 10(0) = 70$ $5x = 70$ $x = \dfrac{70}{5}$ $x = 14$ **x-intercept = (14,0)**
3	**Graph** Plot the two intercepts and draw the line connecting them.	

2. **What is the real-world meaning of the y-intercept in this example?**

3. **What is the real-world meaning of the x-intercept in this example?**

4. **What is easy to see in slope-intercept form but is not so obvious in standard form?**

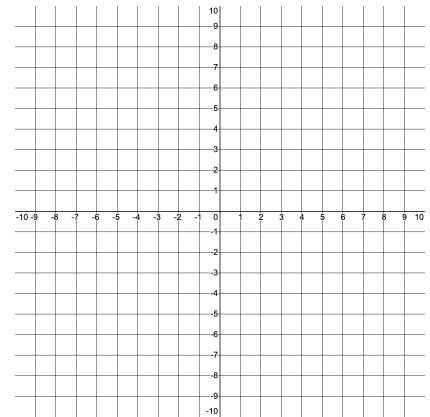5. **What is easier to find using the standard form than using slope-intercept form?**

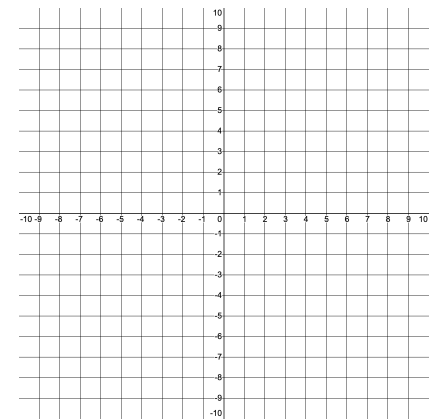**Graphing Practice**

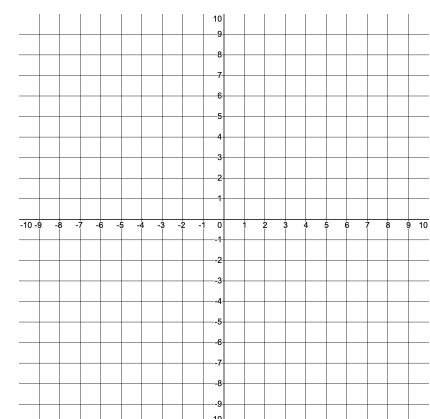Find the x and y intercepts and plot the line on the graph.

1. 2x - 6y = 18

2. 9x + 2y = 18

3. -4x - 8y = 12

EXPLORE IT

Explore: Linear Equations in Standard Form
Follow your teacher's instructions to explore more about the standard form in this Desmos graphing activity.

Reflect: You can see that the standard form and slope-intercept form can look different but describe the same line. Compare the standard form and slope-intercept forms for the three equations in this activity.

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

$$5x - 2y = 10 \qquad\qquad y = -\frac{5}{2}x - 5$$

$$7x - y = 14 \qquad\qquad y = 7x + 1$$

1. **In general, describe how you can find the slope from the standard form equation?**

APPLY IT

Follow your teacher's directions to complete the Application Problems.

Teachers, you can find the Application problems linked in the Lesson Guide.