Name: _____   Date: _____

Student Exploration: Solving Equations by Graphing Each Side

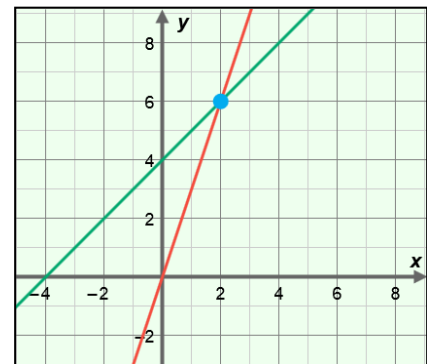**Vocabulary:** equation, expression, identity, solution

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. Yan has four more apples than Xavier. If Xavier has x apples, use x, a number, and an

   operation to write an **expression** for how many apples Yan has. _____

2. Yan also has three times as many apples as Xavier. Write a second expression for how

   many apples Yan has. _____

3. How many apples does Xavier have? _____   How many apples does Yan have? _____
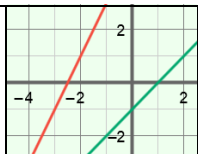
Gizmo Warm-up

One way to solve an **equation** like $3x = x + 4$ is to graph each side. In the *Solving Equations by Graphing Each Side* Gizmo, you will use a graph to find the **solution**, or the value that makes an equation true.

To begin, check that $ax + b = cx + d$ is selected. Set a to 3, b to 0, c to 1, and d to 4. Drag the sliders to vary the values of a, b, c, or, d. You can also change the values by clicking on the number in the text field, typing in a new value, and hitting **Enter**.

1. What equations are graphed in the Gizmo? _____ and _____

2. Mouseover the blue point on the graph. What are its coordinates?   (____, ____)

3. How do the coordinates of the blue point relate to the solution of the equation $3x = x + 4$?

   _____

   _____

Activity A: **Solving equations by graphing**	Get the Gizmo ready: • Be sure $ax + b = cx + d$ is selected.	

1. Consider the equation $2x + 5 = x - 1$.

    A. What two equations can you graph to solve this equation? _____

    Go ahead and graph these two equations in the Gizmo.

    B. What does the blue point on the graph represent? _____

    _____

    C. Mouseover the blue point on the graph. What are its coordinates? (_____, _____)

    D. Based on the coordinates above, what is the solution to $2x + 5 = x - 1$? _____

    Explain. _____

    In the Gizmo, turn on **Show solution on number line** to check your answer.

    E. Select the **TABLE** tab. How can you use the table to check the solution to the

    equation $2x + 5 = x - 1$? _____

    F. Suppose you substitute your solution for x into $2x + 5 = x - 1$. What should be true of

    both sides of the equation once they are simplified? _____

    Why? _____

    G. Substitute the solution for x in the equation $2x + 5 = x - 1$. Then simplify to check
       your answer from above. Show your work.

    H. Use algebra to solve the equation $2x + 5 = x - 1$. Show your work. In the Gizmo,
       select the **SOLUTION** tab to check your answer.

(Activity A continued on next page)

Activity A (continued from previous page)

2. Select the **CONTROLS** tab and *a(x + b) = cx + d*. Turn off **Show solution on number line**. Consider the equation $4(x + 2) = 3x + 4$.

   A. What two equations can you graph to solve this equation? _____

   B. Graph your equations in the Gizmo. What is the solution to $4(x + 2) = 3x + 4$? _____

   How do you know? _____

   Turn on **Show solution on number line** to check your answer in the Gizmo.

   C. Select the **TABLE** tab. Can you use the table to check your answer? _____

   If so, explain how you found the answer using the table. _____

   _____

   D. Solve the equation $4(x + 2) = 3x + 4$ algebraically. Show your work. In the Gizmo, select the **SOLUTION** tab to check your answer.

3. You've used both graphs and algebra to solve equations of the form $ax + b = cx + d$ and

   $a(x + b) = cx + d$. Which method do you find easier? _____
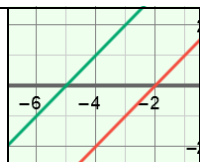
   Explain. _____

4. Use algebra to solve each equation. Then graph the equation in the Gizmo to check your solution. (If necessary, you can use the controls to the right of the graph to zoom in and out. You can also click on the graph and drag to pan it.)

   A. $5x - 2 = 3x + 22$ B. $3(x - 12) = -x + 4$

Activity B: **Special types of solutions**	<u>Get the Gizmo ready</u>: • On the **CONTROL** tab, select $a(x + b) = cx + d$. • Check that **Show solution on number line** is turned on.

1. Consider the equation $2(x + 4) = 2x + 8$.

   A. Do you think this equation has a solution? _____ Explain. _____

   _____

   B. In the Gizmo, graph the equation $2(x + 4) = 2x + 8$. What is the solution to this

   equation? _____ Why? _____

   _____

   In general, an equation that is true for all values of the variable is an **identity**.

   C. Use algebra to solve the equation $2(x + 4) = 2x + 8$. Show your work. In the Gizmo, select the **SOLUTION** tab to check your answer.
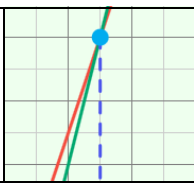
2. Consider the equation $3(x + 4) = 3x + 10$.

   A. Do you think this equation has a solution? _____ Explain. _____

   _____

   B. Select the **CONTROLS** tab and graph the equation $3(x + 4) = 3x + 10$. Is there a

   solution to this equation? _____ Why? _____

   _____

   C. Use algebra to simplify the equation $3(x + 4) = 3x + 10$. Show your work. In the Gizmo, select the **SOLUTION** tab to check your answer.

Activity C: **Using equations**	<u>Get the Gizmo ready</u>: • On the **CONTROL** tab, select **ax + b = cx + d**.	

1. Three times a number plus two is four less than four times the number.

    A. Write an equation that you can use to solve this problem. _____

    B. Use algebra to solve your equation and find the number. Show your work. Then check your answer in the Gizmo.

2. Kari worked twice as many hours as Chris. She also worked ten less than three times as many hours as Mark. Chris and Mark worked the same number of hours.

    A. Let *h* be the number of hours Chris worked. How many hours did Mark work? _____

       How do you know? _____

    B. Use *h* to write two different expressions for the number of hours Kari worked.

       _____   _____

    C. Write an equation to describe this situation. _____

    D. Use algebra to solve your equation. Show your work. Then check your answer in the Gizmo.

    E. How many hours did Chris and Mark work? _____

    F. How many hours did Kari work? _____