Warm-Up

CST/CAHSEE: Grade 8

In the equation $y = 4x + 3$, what is the value of x if y is 7?

A 1

B 2

C 4

D 8

Review: Grade 7

1) Simplify the expression:

$$3(x+2) - 4x + 1$$

2) Which property do you use first above?

Current: Grade 8

Solve the equation.

1) $11 = 26 + b$

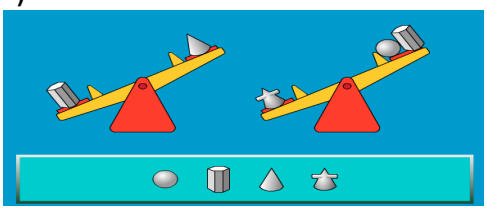
2) $4x = 24$

3) $3/4x = 12$

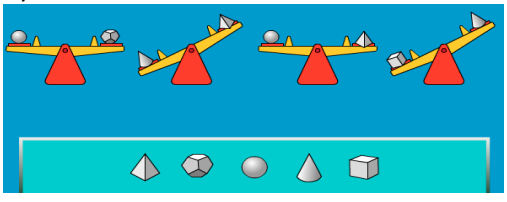
Other: Grade 5

For each problem circle the object that is heaviest.

1)



2)



Warm-Up Solutions

CST/CAHSEE: A

Review: 1) $-x+7$ 2) Distributive Property

Current: 1) -15 2) $x = 6$ 3) 16

Other: 1) 2)

Solving Two Step Equations - Algebra Standard 5.0

Time: 90 mins.

Materials: It is helpful to have a computer; a LCD projector or Smart Board; and a document camera or an overhead projector. This lesson can also be taught with paper and pencil. A copy of the **Note Taking Guide** for each student.

Lesson:

Warm-Up

Have students discuss in pairs what answers they arrived at and how they arrived at that answer. Randomly call on pairs to come up and explain their answers. Check with the other students to see if they have questions or corrections.

T: Today we will solve two-step equations using three methods.

Method #1 – Balance Scales:

T: An equation is the equality of two expressions. One way to model this is by using a balance scale in which one side of the scale is equal to the other side of the scale; therefore, the scale will be horizontal and balanced.

To build the concept of using a balance scale, have students go to this website for 5 mins or you can do as a game with the whole class:
http://www.mathplayground.com/balance_scales.html

Think Pair Share:

T: Which scales from math playground show an equation and which ones show an inequality?

S: The balanced scales were equations and the tilted ones were inequalities.

T: Now we are going to solve equations using a balance scale similar to the one you just explored.

Model using **"Algebra Balance Scales"**at this website:
http://nlvm.usu.edu/en/nav/category_g_4_t_2.html.

Have a few students come up and do different problems in front of the class. This is a good time to have them think of the scale as having equal weight in pounds on both sides. If you want to build your own equations click on **"Create Problem"**. Give your students a few equations to do as a class. You can have them explore on their own for 10 mins. if you have at least one computer for every three students.

Think Pair Share:

T: What is going on with the scale while we are solving the equation?

S: As we take weight off one side, the scale tips to the heavy side since it is not equal. When we take equal weight from both sides, our scale is balance and we can discover the weight of "*x*".

T: When we start solving the equation, the scale is balanced and we can think of the total weight on the right as "*y*". How can we describe the total weight on the left?

S: The total weight on the left is the same so it must be equal to "*y*"; therefore, we can call it "*y*" as well.

T: When we solve for the weight of one "*x*", what do we know about the weight of all of the other "*x*" values?

S: "*x*" has the same weight no matter where the "*x*" is on the scale.

Do **"Example 1: $4x + 2 = 2x + 6$"** with the students and label one side of the equation "*y*". Do the same to the right side of the equation, and write "*y*" = "*y*". Solve the equation and substitute the weight of "*x*" back into the equation to check to see that the total weight "*y*" is the same on both sides.

Method #2 - Decomposing:

Model how to solve equations by decomposing **"Example 1: $4x + 2 = 2x + 6$"** (see solutions).

Think Pair Share:

T: How is solving equations by decomposing similar to using the balance scales?

S: We show each "*x*" on both sides of the equation. We can take away the same "weight" from both sides of the equation to find what "*x*" is.

T: Yes we can eliminate common terms from opposite sides of the equation.

T: If "y" is equal to the total weight on one side of the equation, what other equations can we write from the equation $\mathbf{4x + 2 = 2x + 6}$?

$y =$ _____ and $y =$ _____

S: $\boldsymbol{y = 4x + 2}$ and $\boldsymbol{y = 2x + 6}$.

Method # 3 - Graphing

T: Yes, when we write equations in this way, we can graph them by substituting different "weights" for "*x*" to get different total weights "*y*". We will then take these coordinate points and graph the lines.

"Example 1: $4x + 2 = 2x + 6$": Model how you would pick zero and positive values for "*x*" to substitute into the equation to find "*y*" values for both equations. Have the students use the table worksheet on the next page. You will need at least 4 copies front and back for this lesson. For Example 3 (Example 4) please use the equations $y = 1x + 0$ and $y = 0x + 6$.

Continue the lesson by doing one example with the students and then let them do the "You Try" on their own. They can share their work on the screen and explain their solutions. Ask if there are any questions or corrections and address them as needed. The remaining examples can be assigned for homework.

Challenge: The examples with negative "*x*" values along with the word problem can be assigned as challenge problems. The next lesson would include negative "*x*" values and subtraction.

X	Show Your Work Using Any Method	Y

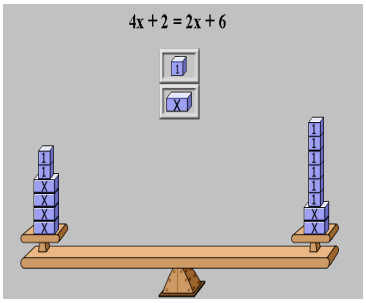
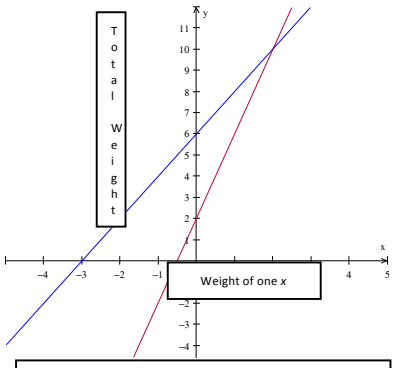
X	Show Your Work Using Any Method	Y

X	Show Your Work Using Any Method	Y

X	Show Your Work Using Any Method	Y

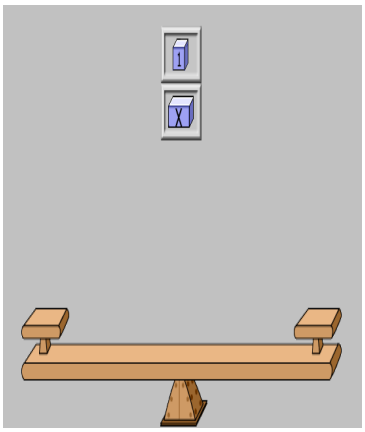
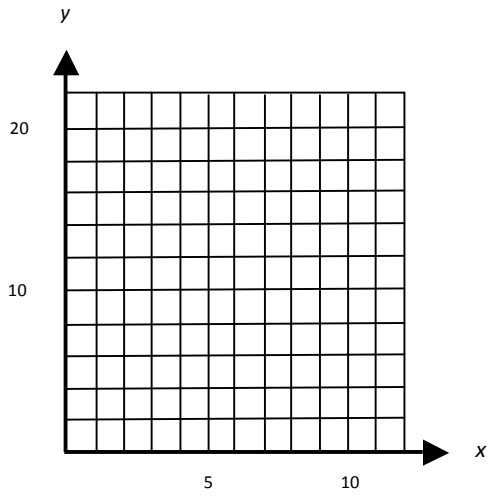
Note Taking Guide: Solving Equations

Example 1: 4x + 2 = 2x + 6

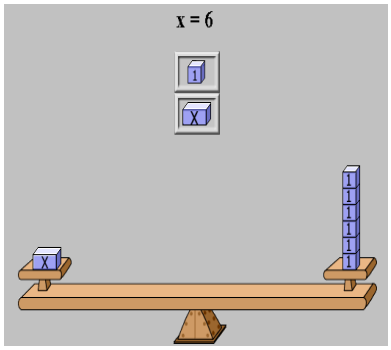
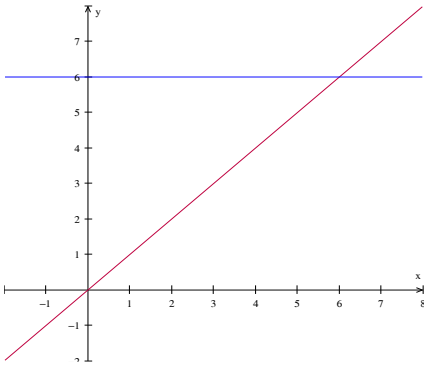
Balance Scale Model	Decomposition	Graphing Method
 x = _____	$4x + 2 = 2x + 6$	 $y = 4x + 2$ and $y = 2x + 6$

"We Try"

Example 2: 5x + 3 = 3x + 7

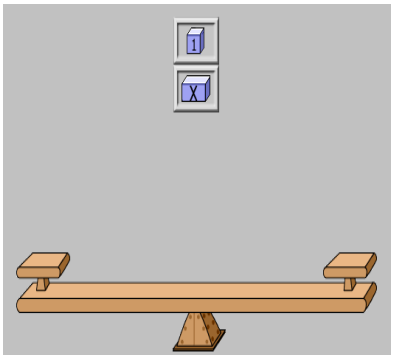
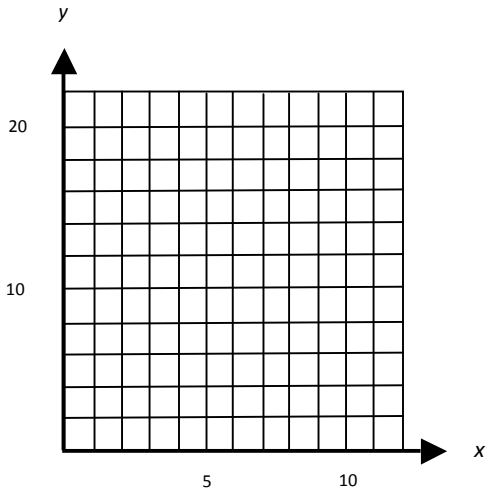
Balance Scale Model	Decomposition	Graphing Method
 x = _____	$5x + 3 = 3x + 7$	 $y = 5x + 3$ and $y = 3x + 7$

Example 3: $x = 6$

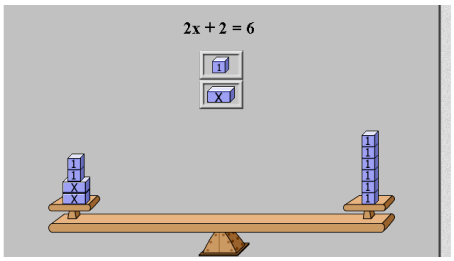
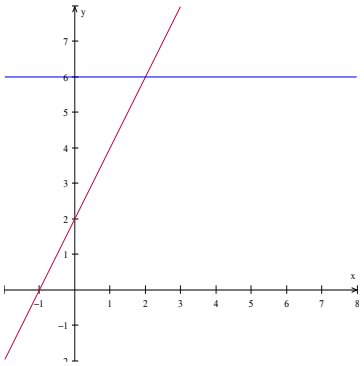
Balance Scale Model	Decomposition	Graphing Method
 $x =$ _____	$x = 6$	 $y = x$ and $y = 6$

"You Try"

Example 4: $x = 3$

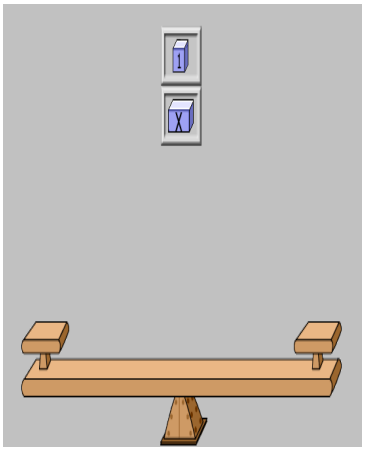
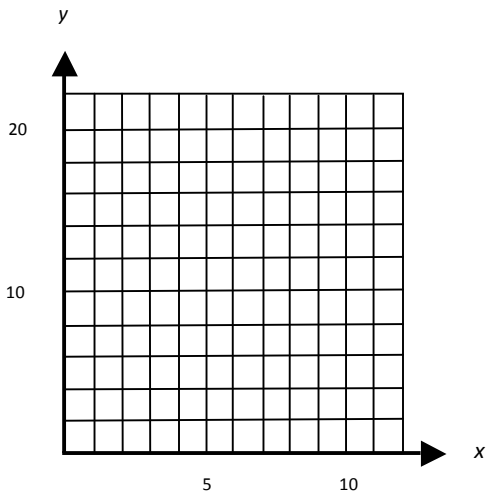
Balance Scale Model	Decomposition	Graphing Method
	$x = 3$	 $y = x$ and $y = 3$

Example 5: $2x + 2 = 6$

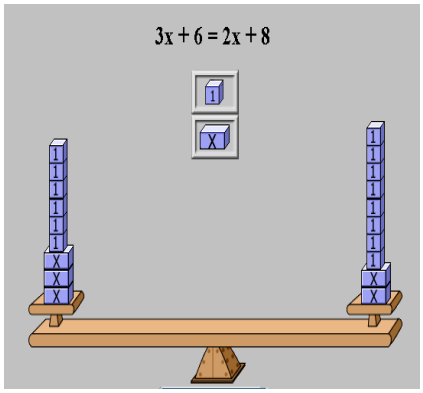
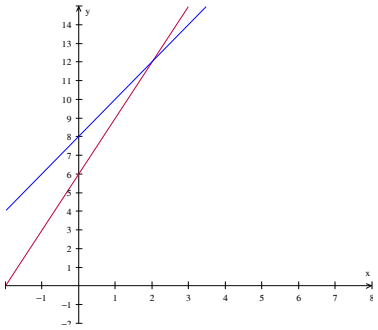
Balance Scale	Decomposition	Graphing Method
 $x =$ _____	$2x + 2 = 6$	 $y = 2x + 2$ and $y = 6$

"You Try"

Example 6: $3x + 1 = 7$

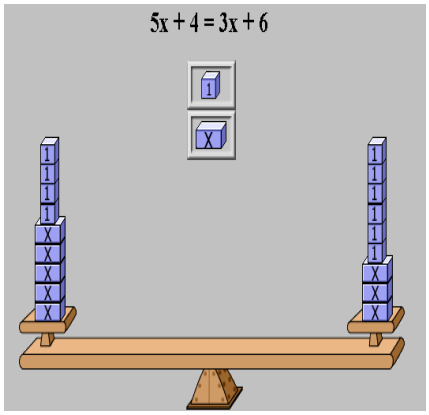
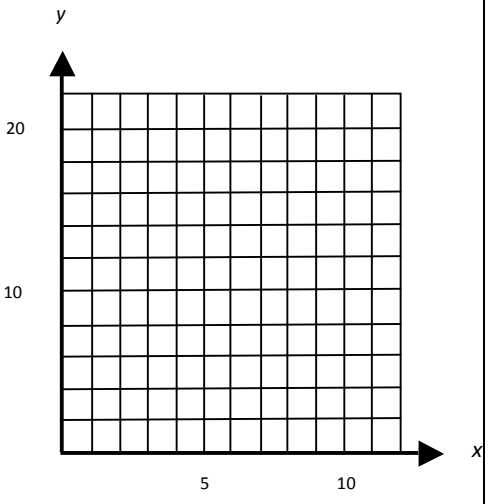
Balance Scale	Decomposition	Graphing Method
 $x =$ _____	$3x + 1 = 7$	 $y = 3x + 1$ and $y = 7$

Example 7: $3x + 6 = 2x + 8$

Balance Scale Model	Decomposition	Graphing Method
 $x =$ _____	$3x + 6 = 2x + 8$	 $y = 3x + 6$ and $y = 2x + 8$

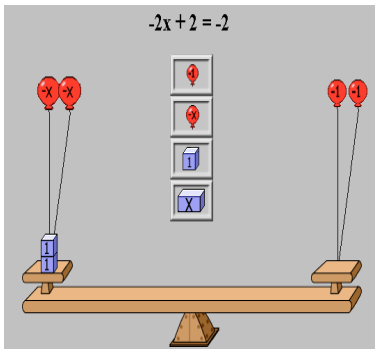
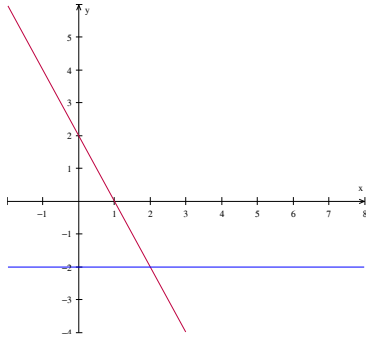
"You Try"

Example 8: $5x + 2 = 4x + 4$

Balance Scale Model	Decomposition	Graphing Method
 $x =$ _____	$5x + 4 = 3x + 6$	 $y = 5x + 2$ and $y = 3x + 8$

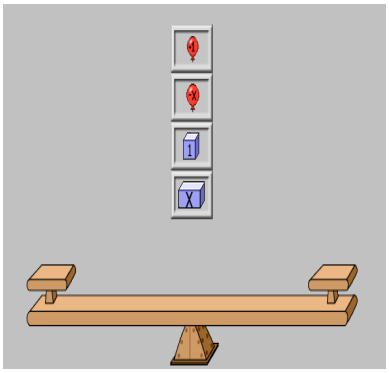
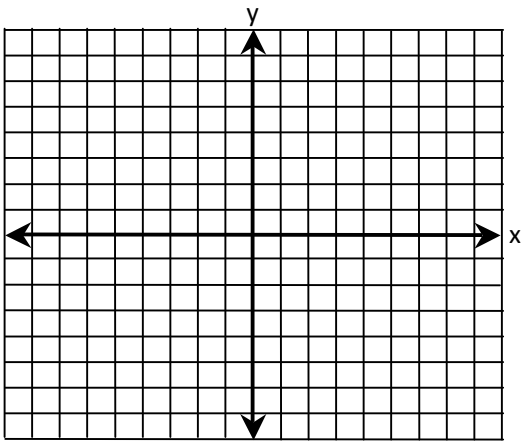
Challenge

Example 9: -2*x* + 2 = -2

Balance Scale	Decomposition	Graphing Method
 *x* = _____	**-2*x* + 2 = -2**	 ***y* = -2*x* + 2 and *y* = -2**

"You Try"

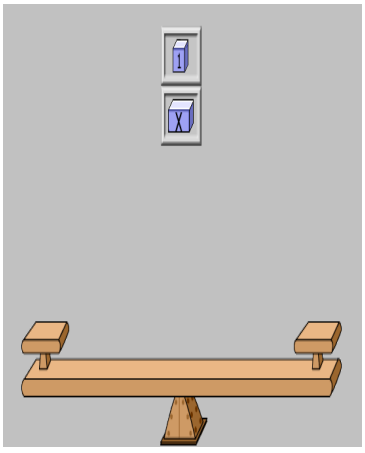
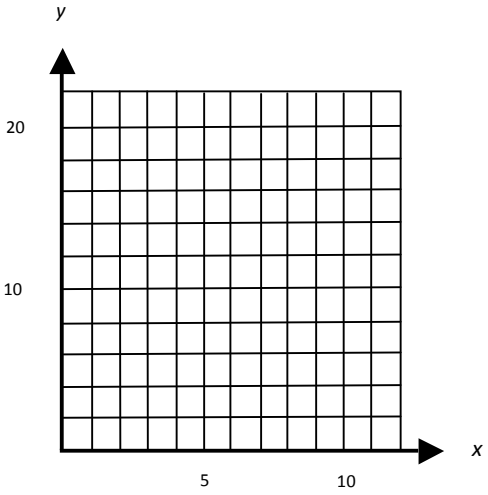
Example 10: -2*x* + 2 = 4

Balance Scale	Decomposition	Graphing Method
 *x* = _____	**-3*x* + 2 = 4**	 ***y* = -3*x* + 2 and *y* = 4**

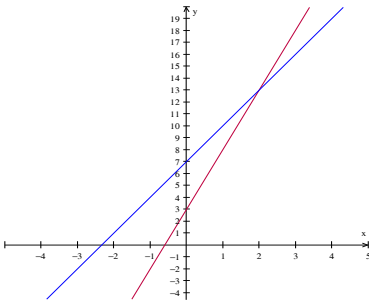
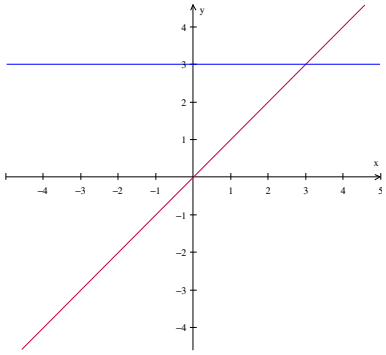
T: I want you to show three ways to solve this word problem:

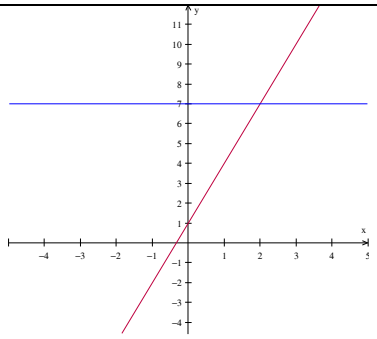
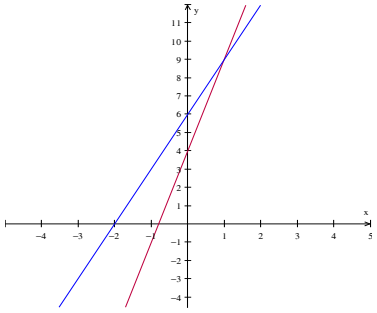
Maranda is trying to make the football team and knows she needs to increase her upper body strength. Her trainer leaves her a barbell containing an equal amount of weight on both sides. One side of the barbell has a 10 lb. plate and three unknown amounts that are the same. On the other side of the barbell there is a 15 lb. plate and two of the same unknown amounts. What is the weight of one of the unknown weights? What is the total weight on each side?
Write an equation to solve this mystery, solve it three ways, and then check to see if both sides are of equal weight.

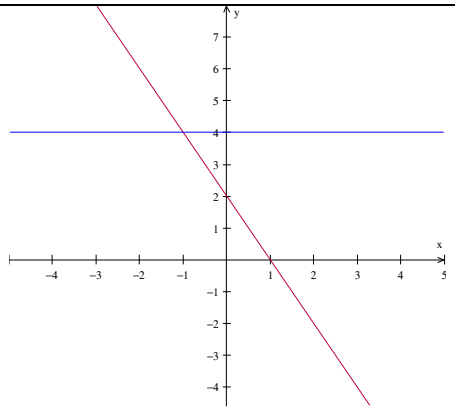
Equation: _____

Balance Scales	Decomposition	Graphing Method
		

Solutions

Examples	Decomposition	Graphing Method
Example 1	$4x + 2 = 2x + 6$ $x + x + x + x + 2 = x + x + 2 + 6$ $x + x = 3 + 3$ $x = 3$	Solution on Notes
Example 2 (Example 3 solutions are on in the notes)	$5x + 3 = 3x + 7$ $x + x + x + x + x + 3 = x + x + x + 3 + 4$ $x + x = 2 + 2$ $x = 2$	
Example 4	$x = 3$ $2x + 2 = 6$ $x + x + 2 = 2 + 4$	 Solution on Notes
Example 5	$x + x = 2 + 2$ $x = 2$	

Example	Decomposition	Graphing Method
Example 6	$3x + 1 = 7$ $x + x + x + 1 = 1 + 6$ $x + x + x = 2 + 2 + 2$ $x = 2$	
Example 7	$3x + 6 = 2x + 8$ $x + x + x + 6 = x + x + 6 + 2$ $x = 2$	Solution on Notes
Example 8	$5x + 4 = 3x + 6$ $x + x + x + x + x + 4 = x + x + x + 4 + 2$ $x + x = 1 + 1$ $x = 1$	
Example 9	$-2x + 2 = -2$ $-x + -x + 2 = -2$ $-x + -x + 2 + (-2) = -2 + (-2)$ $-x + -x = -2 + (-2)$ $-x = -2$ $\therefore x = 2$	Solution on Notes

Example 10	$-2x + 2 = 4$ $-x + -x + 2 = 2 + 2$ $-x + -x = 1 + 1$ $-x = 1$ $\therefore x = -1$	
Word Problem	$3x + 10 = 2x + 15$ $x + x + x + 10 = x + x + 10 + 5$ $x = 5$ lbs