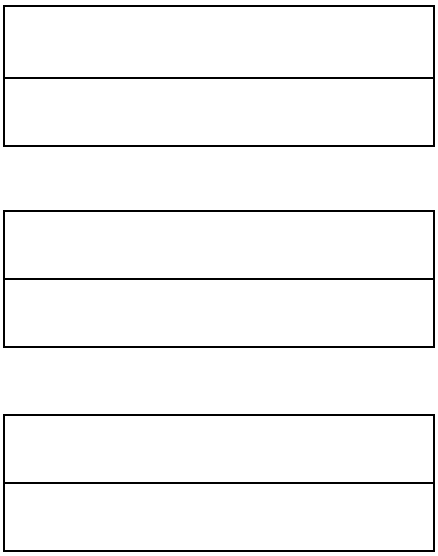
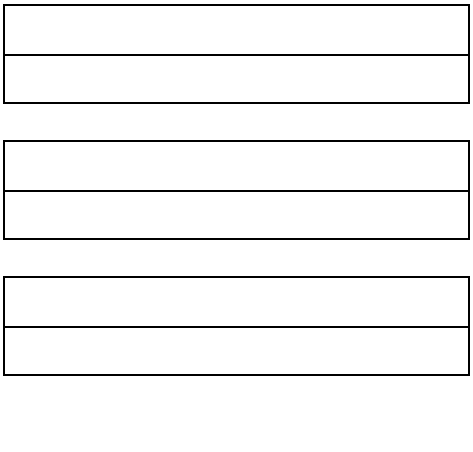
Note taking guide: Solving equations with variables on both sides of the equal sign

Example 1: $3x + 7 = 2x + 20$

Bar Model	Decompose	Traditional
$3x + 7 = 2x + 20$ 	$3x + 7 = 2x + 20$	$3x + 7 = 2x + 20$ **#1** **#2**

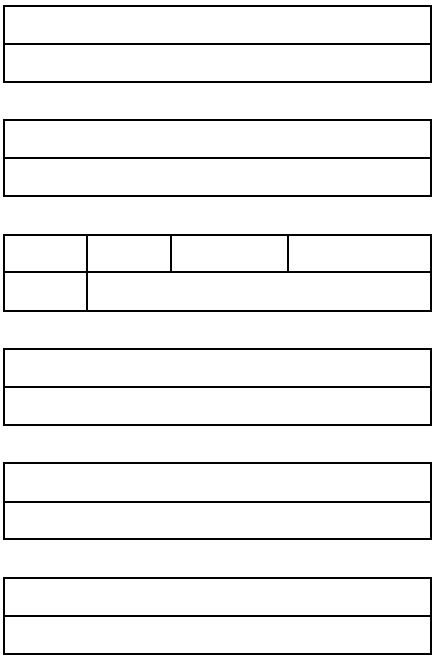
"You Try" for Example 1: $4x + 8 = 5x + 3$

Solution

Bar Model	Decompose	Traditional
$4x + 8 = 5x + 3$  $x =$	$4x + 8 = 5x + 3$	$4x + 8 = 5x + 3$

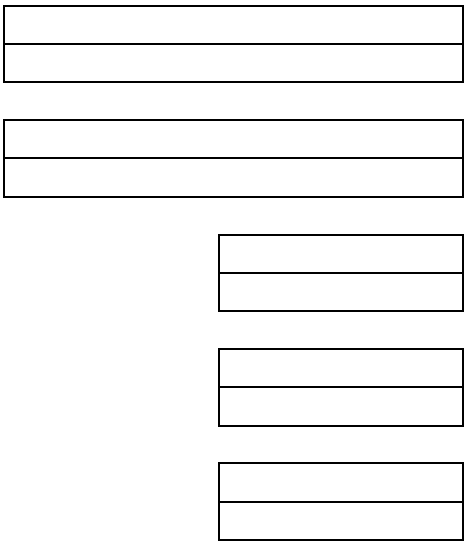
Note taking guide: Solving equations with variables on both sides of the equal sign

Example 2: $-2x + 4 = x + 7$

Bar Model	Decompose	Traditional
$-2x + 4 = x + 7$ 	$-2x + 4 = x + 7$	$-2x + 4 = x + 7$

"You Try" for Example 2: $-2x - 4 = -3x + 3$

Solution

Bar Model	Decompose	Traditional
$-2x - 4 = -3x + 3$ 	$-2x - 4 = -3x + 3$	$-2x - 4 = -3x + 3$

Note taking guide: Solving equations with variables on both sides of the equal sign

Example 3: $5x + 3 + 2x = 7x - 4$

Bar Model	Decompose	Traditional
$5x + 3 + 2x = 7x - 4$	$5x + 3 + 2x = 7x - 4$	$5x + 3 + 2x = 7x - 4$

"You Try" for Example 3: $6x + 5 = 4x - 5 + 2x$

Solution

Bar Model	Decompose	Traditional
$6x + 5 = 4x - 5 + 2x$	$6x + 5 = 4x - 5 + 2x$	$6x + 5 = 4x - 5 + 2x$

Note taking guide: Solving equations with variables on both sides of the equal sign

Example 4: $5x + 3 - 2x = 2 + 3x + 1$

Bar Model	Decompose	Traditional
$5x + 3 - 2x = 2 + 3x + 1$	$5x + 3 - 2x = 2 + 3x + 1$	$5x + 3 - 2x = 2 + 3x + 1$
		Traditional #1
		Traditional #2

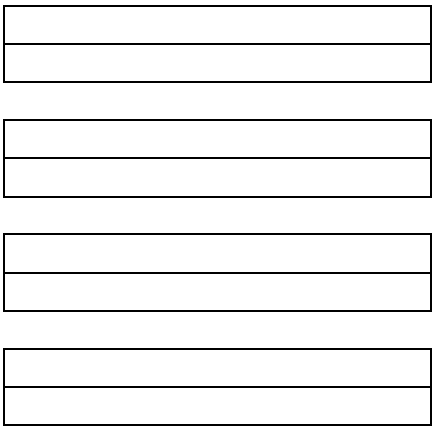
"You Try" for Example 4: $4x - 2 + 3x = 11x - 2 - 4x$

Solution

Bar Model	Decompose	Traditional
$4x - 2 + 3x = 11x - 2 - 4x$	$4x - 2 + 3x = 11x - 2 - 4x$	$4x - 2 + 3x = 11x - 2 - 4x$

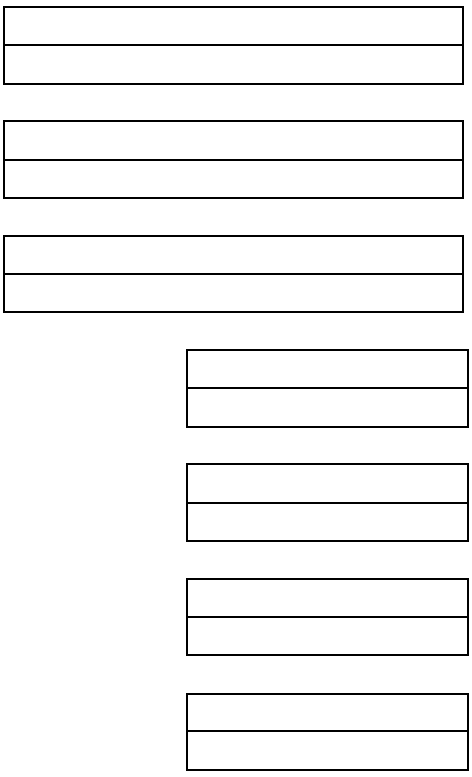
Note taking guide: Solving equations with variables on both sides of the equal sign

Example 5: $3(x+1) = 2x+5$

Bar Model	Decompose	Traditional
$3(x+1) = 2x+5$ 	$3(x+1) = 2x+5$	$3(x+1) = 2x+5$

"You Try" for Example 5: $2(x+3) = 4x+10$

Solution

Bar Model	Decompose	Traditional
$2(x+3) = 4x+10$ 	$2(x+3) = 4x+10$	$2(x+3) = 4x+10$

Date: _____

Solving Equations: variables on both sides

Warm-Up

CST/CAHSEE:

CST Algebra 1

Which statement about Stan's solution is true?

Stan made a mistake in Step 3. Stan made a mistake in Step 5.

Step 1: $n + 8n + 20 = 110$

Step 2: $9n + 20 = 110$

Step 3: $9n = 110 - 20$

Step 4: $9n = 90$

Step 5: $n = 10$

Which is the first *incorrect* step in the solution shown above?

A) Stan's solution is correct.

B) Stan made a mistake in Step 1.

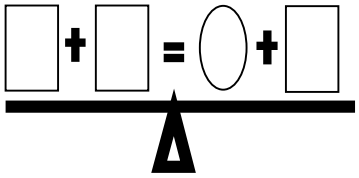
C) Stan made a mistake in Step 3.

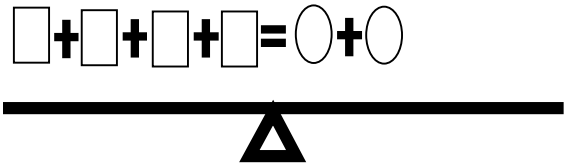
D) Stan made a mistake in Step 5.

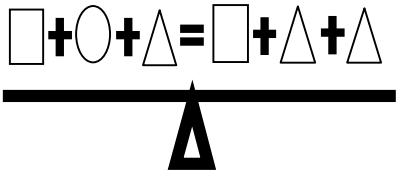
5.0

Review:

What is circle equal to?







Current:

Write the zero pair for the given terms:

a) 4

b) -18

c) 2x

d) -7y

Other:

Look at the two equations below.

$2x + 3x = 20$ and $3x = 2x + 20$

What is the difference between them? Do they have the same solutions? Can you prove it?

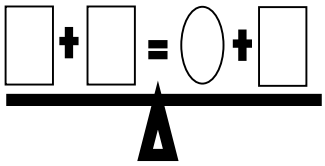
What are some other common mistakes you see your students making in this type of question.

Today's Objective/Standards: 5.0 Students solve multistep problems, involving linear equations and linear inequalities in one variable and provide justification for each step.

Balance Beam Game

This game can be played the day before teaching Solving variables on both sides to introduce the idea of removing from both sides.

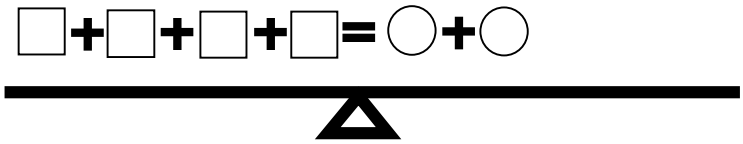
Say, "Let's play a game" *Write on board*.



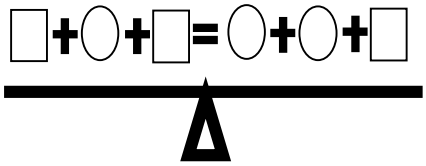
Say, "Can you tell me what circle is equal to?"
Answer, "One square"
"Fabulous!"

Discuss the "sides" of the balance and relate to the equal sign. Good time to review

Say, "Let's try this one." *Write on board*

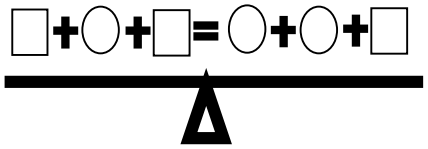
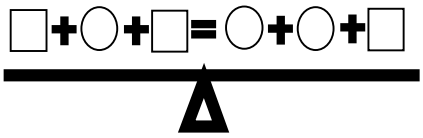
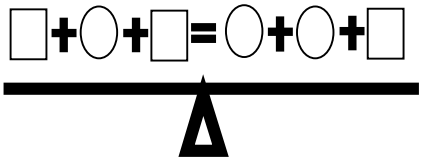
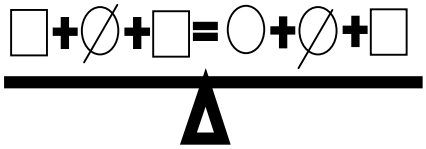
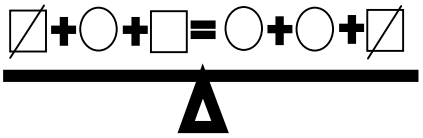
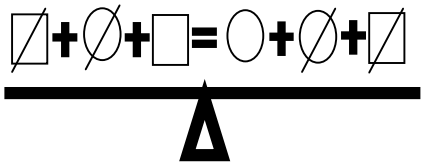
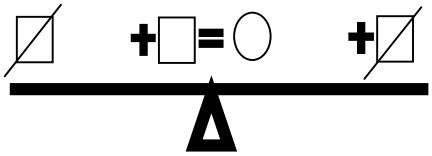
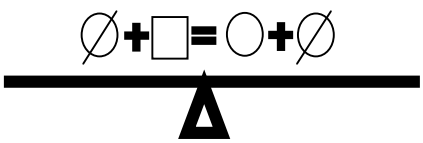
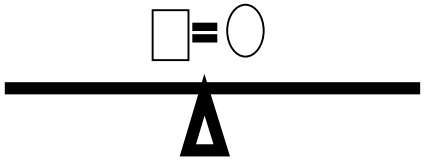
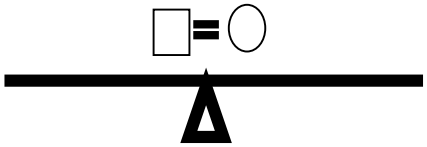
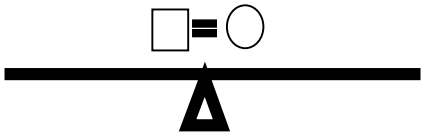


Say, "What is circle equal to?"
Answer, Choral response "two squares!" Ask/Discuss why this time there is TWO squares emphasize value.
"Beautiful! Let's try another one. "

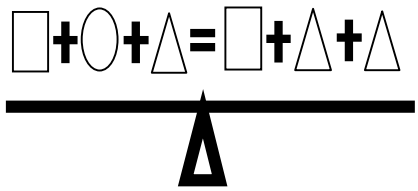


Have them think pair share how they solved and other possible ways to solve.

Write on Board different options in finding answer.

Removing Circles First	Removing Squares First	Removing Both
		
		
		
		

**Optional if time allows or to have another example: Say, "Now let's try one more."
Write



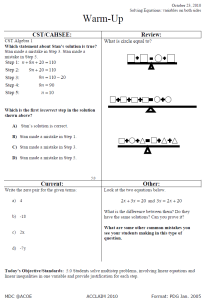
Please note that this lesson is designed for a block schedule period. If you have a traditional period you complete this lesson over the course of two days.

You'll notice throughout this lesson that we are working horizontally not vertically. We've seen that this alleviates many issues that come up.

We also want you to notice the common occurrences in all the three methods. Point them out to your students or have them point them out to you.

We want them to do the other methods so that they gain a better understanding of the traditional method. Over time we want them to do the traditional method.

Warm up


Warm-Up

CST/CAHSEE:

Review:

Current:

Other:

Debrief all problems except "other" this will be the beginning of the lesson.

Begin debriefing the last question

Write on board.

$2x + 3x = 20$ $3x = 2x + 20$

Say, "What is the difference between the two equations?"
gather answer's from students

Write on board.

$2x + 3x = 20$ $3x = 2x + 20$
Variables are on the same side Variables are on both sides
*Say, "*Let's prove they are different. Let's first solve the equation on the left side.*"*

BOARD

$2x + 3x = 20$ $3x = 2x + 20$
Variables are on the same side Variables are on both sides

$5x = 20$

$x = 4$

Say, "If we take that solution and substitute that into the second equation, we get"

BOARD

$2x + 3x = 20$
Variables are on the same side
$5x = 20$
$x = 4$

$3x = 2x + 20$
Variables on both sides
$3(4) = 2(4) + 20$
$12 = 8 + 20$
$12 \neq 28$

Write and say:
Solution is not the same for both equations. They are not EQUIVALENT equations.

REMEMBER: Main goal of solving is to ISOLATE THE VARIABLE to one side

This is a good time to review/discuss equivalent equations.

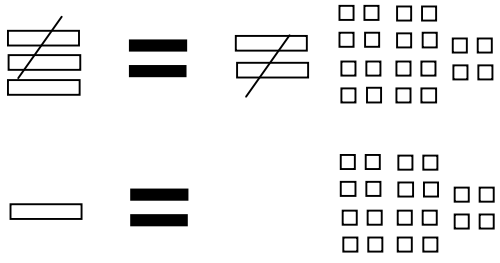
Have students take the following notes on a piece of paper/in their notebook.
Notes:

Bar Model	**Decompose**	**Traditional**
$3x = 2x + 20$ $3x$ $2x + 20$ x x x x x 20 *Say*: "decompose using repeated addition."	$3x = 2x + 20$ $3x = 2x + 20$ $x + x + x = x + x + 20$ $x + \not{x} + \not{x} = \not{x} + \not{x} + 20$ $x = 20$ *Say*: "decompose using repeated addition." "eliminate common terms from both sides"	$3x = 2x + 20$ $3x - 2x = 2x - 2x + 20$ $x = 20$ *Say:"*make a zero using a zero pair with $2x$ and $-2x$ "

Algebra Tiles

This last method can be used as a fourth method or for remediation (such as support classes or reteaching).

$3x = 2x + 20$



$x = 20$

Pass out note taking guide to take the remaining notes.

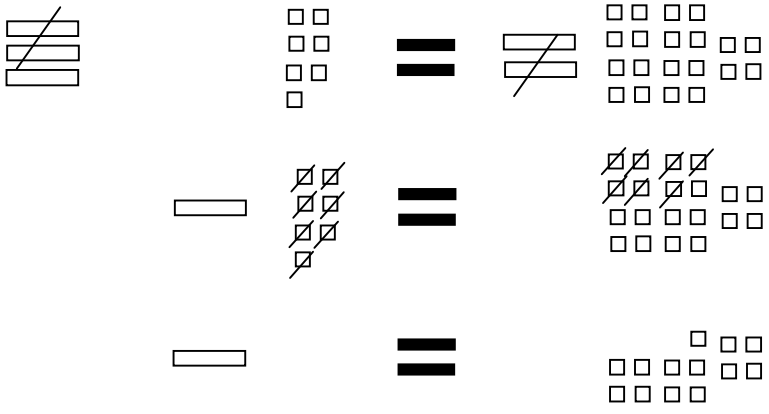
Example 1: $3x + 7 = 2x + 20$ Use the same prompts from the previous example as you solve the following.

Bar Model	Decompose	Traditional
$3x + 7 = 2x + 20$ $3x + 7$ $2x + 20$ x x x 7 x x 20 x x x 7 x x 13 7	$3x + 7 = 2x + 20$ $3x + 7 = 2x + 20$ $3x + 7 = 2x + 13 + 7$ $x + x + x = x + x + 13$ $x = 13$	$3x + 7 = 2x + 20$ **#1** $3x - 2x + 7 = 2x - 2x + 20$ $x + 7 = 20$ $x + 7 - 7 = 20 - 7$ $x = 13$ **#2** $3x + 7 = 2x + 20$ $3x + 7 - 7 = 2x + 20 - 7$ $3x = 2x + 13$ $3x - 2x = 2x - 2x + 13$ $x = 13$ *Show students that you don't need to start with the variable.* *Remind students that when we solve we are looking to make zeros and ones.* *Here ask," which one would You do first?"* *Do "think-pair-share" with each other to discuss/compare doing either/both.*

Algebra Tiles

$3x + 7 = 2x + 20$

This last method can be used as a fourth method or for remediation such as support classes or reteaching.



$x = 13$

"You Try" for Example 1: $4x + 8 = 5x + 3$

After sufficient time for students to complete and/or for you to circulate write the solution

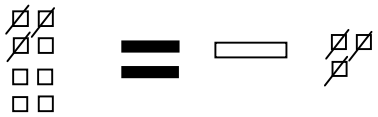
Solution

Bar Model	Decompose	Traditional
$4x + 8 = 5x + 3$	$4x + 8 = 5x + 3$	$4x + 8 = 5x + 3$
<table><tr><td colspan="6">$4x + 8$</td></tr><tr><td colspan="6">$5x + 3$</td></tr></table>	$4x + 5 + 3 = 5x + 3$	$4x + 8 - 3 = 5x + 3 - 3$
	$4x + 5 = 5x$	$4x + 5 = 5x$
<table><tr><td>x</td><td>x</td><td>x</td><td>x</td><td colspan="2">8</td></tr><tr><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>3</td></tr></table>	$x + x + x + x + 5 = x + x + x + x + x$	$4x - 4x + 5 = 5x - 4x$
	$5 = x$	$5 = x$
<table><tr><td>x</td><td>x</td><td>x</td><td>x</td><td>5</td><td>3</td></tr><tr><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>3</td></tr></table>	$x = 5$	$x = 5$
$x = 5$		

Algebra Tiles

This last method can be used as a fourth method or for remediation such as support classes or reteaching.

$4x + 8 = 5x + 3$



$5 = x$

$x = 5$

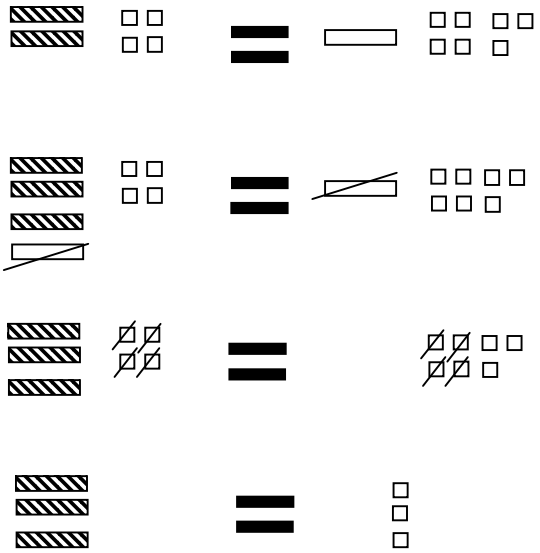
Example 2: $-2x + 4 = x + 7$

Bar Model	Decompose	Traditional
$-2x + 4 = x + 7$	$-2x + 4 = x + 7$	$-2x + 4 = x + 7$
$-2x + 4$ $x + 7$	$-2x + 4 = x + 7$ $-x + -x + 4 = x + 3 + 4$ $-x + -x + -x + x = x + 3$ $-x + -x + -x = 1 + 1 + 1$ $-x = 1$ $x = -1$	$-2x + 4 = x + 7$ $-2x + 2x + 4 = x + 2x + 7$ $4 = 3x + 7$ $4 - 7 = 3x + 7 - 7$ $-3 = 3x$ $-1 = x$
$-2x$ | 4 x | 7		
x | $-x$ | $-2x$ | 4 x | 7		
x | $-x$ | $-2x$ | 4 x | 3 | 4	Other ways to resolve $-x = 1$ 1) Say " the Opposite of x is equal to 1 so then x is equal to negative one."	
$-x$ | $-2x$ 3	2) $-x = 1$ $-x = 1 + x + (-x)$ $1 + -1 + (-x) = 1 + x + (-x)$ $-1 = x$	
$-x$ | $-x$ | $-x$ 1 | 1 | 1 $-x = 1$ $x = -1$		

Algebra Tiles

This last method can be used as a fourth method or for remediation such as support classes or reteaching.

$-2x + 4 = x + 7$



$-x = 1$

$1 = x$

"You Try" for Example 2: $-2x-4=-3x+3$

After sufficient time for students to complete and/or for you to circulate write the solution

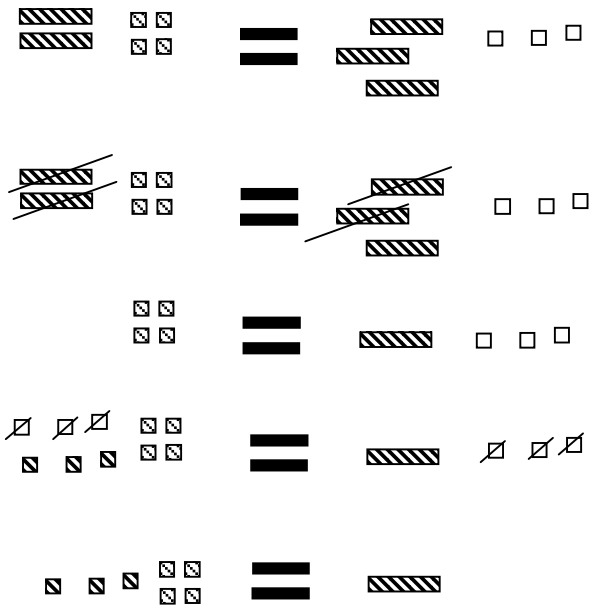
Solution

Bar Model	Decompose	Traditional
$-2x-4=-3x+3$	$-2x-4=-3x+3$	$-2x-4=-3x+3$
$-2x-4$ / $-3x+3$	$-2x-4=-x+-2x+3$	$-2x+3x-4=-3x+3x+3$
$-x$ | $-x$ | -4 / $-x$ | $-x$ | $-x$ | 3	$-4=-x+3$	$x-4=3$
-4 | -3 | 3 / $-x$ | 3	$-4+-3+3=-x+3$	$x-4+4=3+4$
-7 | 3 / $-x$ | 3	$-4+-3=-x$	$x=7$
-7 / $-x$	$-7=-x$	
$-x=-7$	$7=x$	
$x=7$	$x=7$	

Algebra Tiles

This last method can be used as a fourth method or for remediation such as support classes or reteaching.

$-2x-4=-3x+3$



$-x=-7$

$x=7$

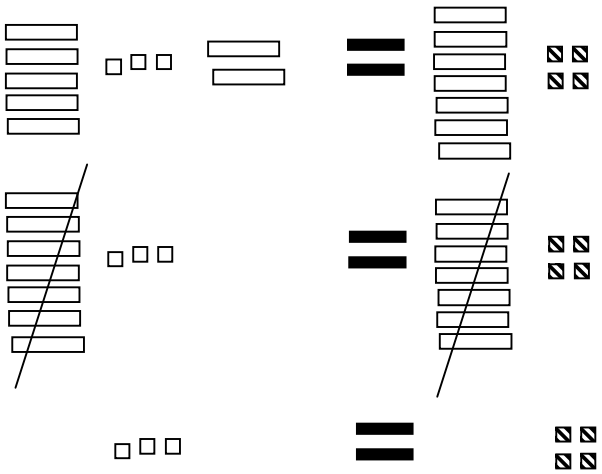
Example 3: $5x + 3 + 2x = 7x - 4$

Bar Model	Decompose	Traditional
$5x + 3 + 2x = 7x - 4$ $5x + 3 + 2x$ / $7x - 4$ $5x$ | $2x$ | 3 / $7x$ | -4 $3 \neq -4$ **No Solution**	$5x + 3 + 2x = 7x - 4$ $5x + 2x + 3 = 7x - 4$ $7x + 3 = 7x - 4$ $3 \neq -4$ **No Solution**	$5x + 3 + 2x = 7x - 4$ $5x + 3 + 2x = 7x - 4$ $7x + 3 = 7x - 4$ $7x - 7x + 3 = 7x - 7x - 4$ $3 \neq -4$ **No Solution**

Algebra Tiles

This last method can be used as a fourth method or for remediation such as support classes or reteaching.

$5x + 3 + 2x = 7x - 4$



$3 \neq -4$

"You Try" for Example 3: $6x + 5 = 4x - 5 + 2x$

After sufficient time for students to complete and/or for you to circulate write the solution.

Solution

Bar Model

$6x + 5 = 4x - 5 + 2x$

$6x + 5$
$4x - 5 + 2x$

$6x$		5
$4x$	-5	$2x$

$6x$		5
$4x$	$2x$	-5

$5 \neq -5$

No Solution

Decompose

$6x + 5 = 4x - 5 + 2x$

$6x + 5 = 4x + 2x - 5$

$6x + 5 = 6x - 5$

$5 \neq -5$

No Solution

Traditional

$6x + 5 = 4x - 5 + 2x$

$6x + 5 = 4x + 2x - 5$

$6x + 5 = 6x - 5$

$6x - 6x + 5 = 6x - 6x - 5$

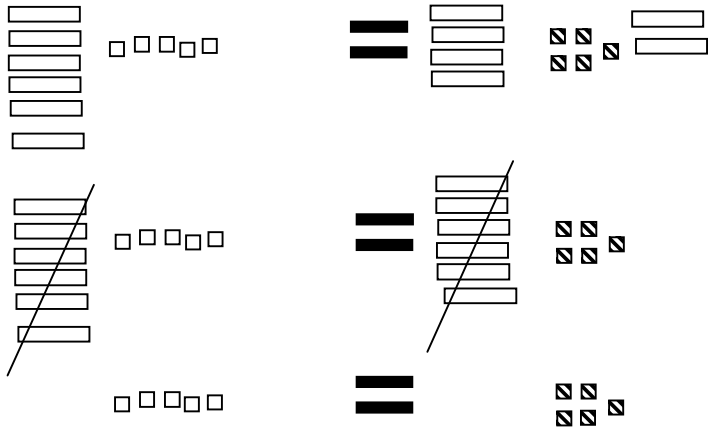
$5 \neq -5$

No Solution

Algebra Tiles

$6x + 5 = 4x - 5 + 2x$

This last method can be used as a fourth method or for remediation such as support classes or reteaching.



$5 \neq -5$

Example 4: $5x + 3 - 2x = 2 + 3x + 1$

Bar Model

$5x + 3 - 2x = 2 + 3x + 1$

$5x + 3 - 2x$
$2 + 3x + 1$

$5x$	$-2x$	3
$3x$		3

$3x$	3
$3x$	3

x	x	x	3
x	x	x	3

$x = x$

All Real Numbers

Decompose

$5x + 3 - 2x = 2 + 3x + 1$

$5x - 2x + 3 = 2 + 3x + 1$

$3x + 3 = 3x + 3$

$3x = 3x$

$x + x + x = x + x + x$

$x = x$

All Real Numbers

Traditional

$5x + 3 - 2x = 2 + 3x + 1$

Traditional #1

$5x + 3 - 2x = 2 + 3x + 1$

$3x + 3 = 3x + 3$

$3x - 3x + 3 = 3x - 3x + 3$

$3 = 3$

All Real Numbers

Traditional #2

$5x + 3 - 2x = 2 + 3x + 3$

$3x + 3 = 3x + 3$

$3x + 3 - 3 = 3x + 3 - 3$

$3x = 3x$

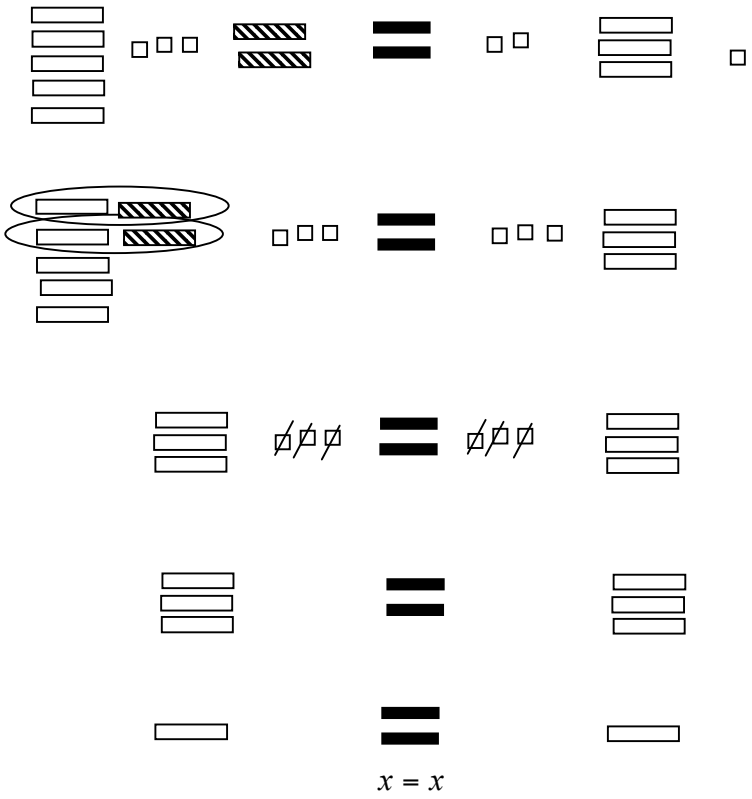
$x = x$

All Real Numbers

Algebra Tiles

$5x + 3 - 2x = 2 + 3x + 1$

This last method can be used as a fourth method or for remediation such as support classes or reteaching.



$x = x$

All Real Numbers

"You Try" for Example 4: $4x - 2 + 3x = 11x - 2 - 4x$

After sufficient time for students to complete and/or for you to circulate write the solution.

Solution

Bar Model

$4x - 2 + 3x = 11x - 2 - 4x$

$4x - 2 + 3x$
$11x - 2 - 4x$

$4x$	-2	$3x$
$11x$	-2	$-4x$

$4x + 3x$	-2
$11x - 4x$	-2

$7x$	-2
$7x$	-2

$7x = 7x$

$x = x$

All Real Numbers

Decompose

$4x - 2 + 3x = 11x - 2 - 4x$

$4x + 3x - 2 = 11x - 4x - 2$

$7x - 2 = 7x - 2$

$7x = 7x$

$x = x$

All Real Numbers

Traditional

$4x - 2 + 3x = 11x - 2 - 4x$

$4x + 3x - 2 = 11x - 4x - 2$

$7x - 2 = 7x - 2$

$7x - 2 + 2 = 7x - 2 + 2$

$7x = 7x$

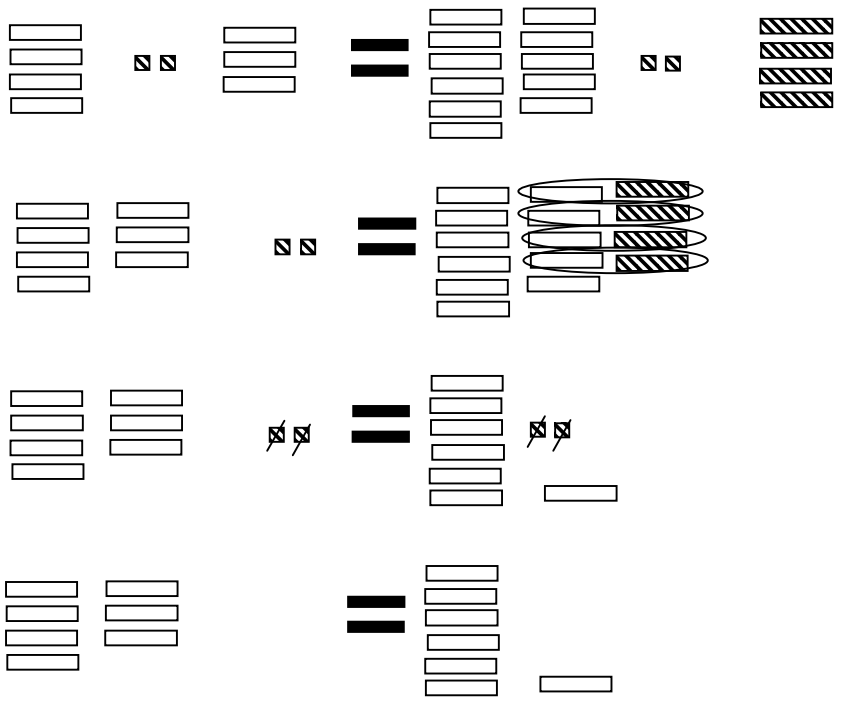
$x = x$

All Real Numbers

Algebra Tiles

This last method can be used as a fourth method or for remediation such as support classes or reteaching.

$4x - 2 + 3x = 11x - 2 - 4x$



$7x = 7x$

$x = x$

All Real Numbers

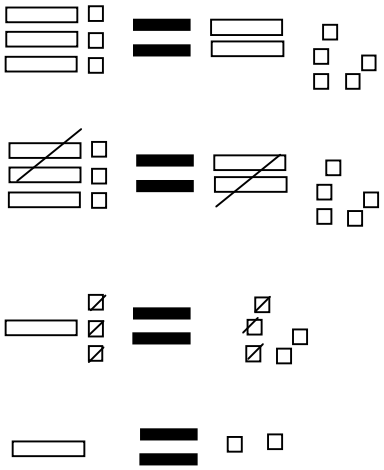
Example 5 $3(x+1) = 2x+5$

Bar Model	Decompose	Traditional
$3(x+1) = 2x+5$ $3(x+1)$ $2x+5$ $x+1$ | $x+1$ | $x+1$ $2x$ | 5 x | x | x | 3 x | x | 5 x | x | x | 3 x | x | 2 | 3 $x = 2$	$3(x+1) = 2x+5$ $(x+1)+(x+1)+(x+1) = 2x+5$ $x+x+x+1+1+1 = x+x+5$ $x+x+x+3 = x+x+2+3$ $x+3 = 2+3$ $x = 2$	$3(x+1) = 2x+5$ $3(x)+3(1) = 2x+5$ $3x+3 = 2x+5$ $3x-2x+3 = 2x-2x+5$ $x+3 = 5$ $x+3-3 = 5-3$ $x = 2$

Algebra Tiles

This last method can be used as a fourth method or for remediation such as support classes or reteaching.

$3(x+1) = 2x+5$



$x = 2$

All Real Numbers

"You Try" for Example 5: $2(x+3) = 4x+10$

After sufficient time for students to complete and/or for you to circulate write the solution.

Solution

Bar Model	Decompose	Traditional
$2(x+3) = 4x+10$	$2(x+3) = 4x+10$	$2(x+3) = 4x+10$
	$(x+3)+(x+3) = 4x+10$	$2(x)+2(3) = 4x+10$
	$2x+6 = 2x+2x+10$	$2x+6 = 4x+10$
	$6 = 2x+10$	$2x-2x+6 = 4x-2x+10$
	$6-10+10 = 2x+10$	$6 = 2x+10$
	$-4 = 2x$	$6-10 = 2x+10-10$
	$-2+-2 = x+x$	$-4 = 2x$
	$-2 = x$	$-2 = x$
	$x = -2$	

$2(x+3)$
$4x+10$

$(x+3)$	$(x+3)$
$4x$	10

x	x	6		
x	x	x	x	10

6		
x	x	10

$6+(-10)$		10
x	x	10

-4		10
x	x	10

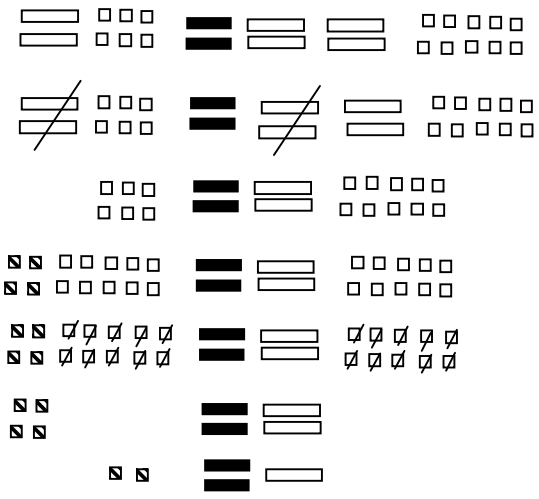
-2	-2	10
x	x	10

$x = -2$

Algebra Tiles

This last method can be used as a fourth method or for remediation such as support classes or reteaching.

$2(x+3) = 4x+10$



$2 = x$

All Real Numbers

N**otice throughout this lesson that we are working horizontally not vertically. We've seen that this alleviates many of the issues that come up.**

Notice the common occurrences in all the three methods. Point them out to your students or have them point them out to you.

We want them to do the other methods so that they gain a better understanding of the traditional method. Over time we want them to do the traditional method.

NOTE:
Homework
To incorporate the multiple methods it is highly encouraged to assign fewer problems to be done multiple ways.