From Integers to Factoring – Using Algebra Tiles in the Classroom

2019 GED Annual Conference

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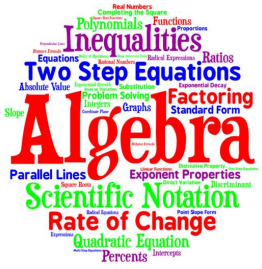
During this Workshop, we will…

- Practice using algebra tiles to help students obtain conceptual understanding of the fundamentals of algebra
  - Positive and negative integers
  - Additive inverse (Zero Pairs)
  - Binomials, polynomials
- Discuss importance of contextualizing instruction to help students see the real-world application of algebra
- Identify and use a variety of online and other instructional resources for the classroom.



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What Are Some Ways to Solve These Problems

- Each section of the Bradley Center holds 258 people. There are 72 sections. If all of the seats are filled for a Buck's game, how many people would there be?

- How many bows can you make from 3 2/3 meters of ribbon if you need 2/5 meters of ribbon to make each bow?

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Would the Same Methods Work?

- Each section of the Bradley Center holds *p* people. There are *s* sections. If all of the seats are filled for a Buck's game, how many people would there be?

- How many bows can you make from *r* meters of ribbon if you need *m* meters of ribbon to make each bow?

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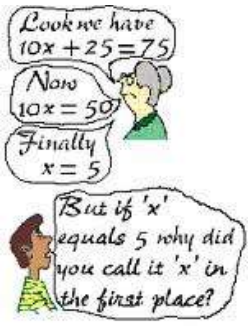
Remember . . .

- Arithmetic is doing something to numbers to get an answer.
- Algebra is exploring the relationships between numbers.



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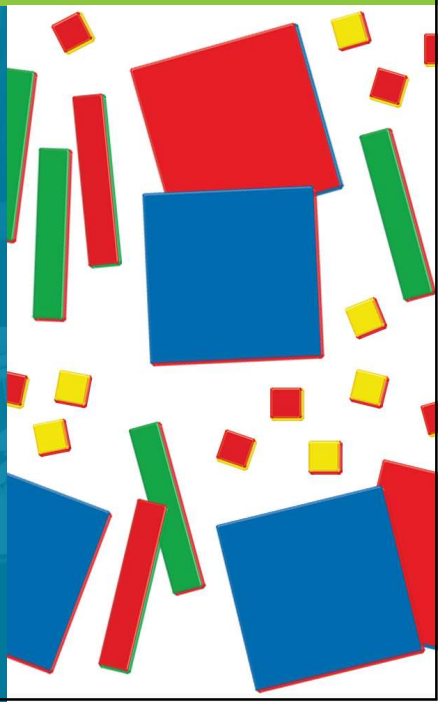
Helping Students Build Understanding of Basic Algebraic Concepts



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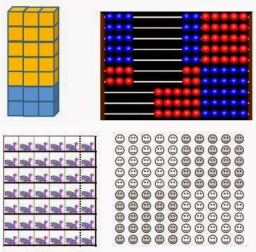
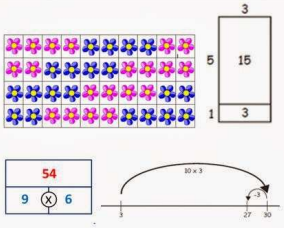
C-R-A – Essential for Understanding

Concrete	Representational	Abstract
Students manipulate hands-on, concrete materials	Students draw and observe diagrams, or watch the teacher touching and moving hands-on materials	Numbers and mathematical symbols
		x 4 Patterns: 4, 8, 12, 16, 20 / 24, 28, 32, 36, 40 8 x 5 (4 x 2) x 5 4 x (2 x 5) 4 x 10 40 45 ÷ 5 (50-5) ÷ 5 (50÷5) - (5÷5) 10-1 9

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Manipulatives for Algebra (CRA)

algebra tiles, algetiles, math tiles, virtual tiles

- Students with access to virtual manipulatives achieved higher gains than those students taught without manipulatives.
- Students using hands-on and manipulatives were able to explain the how and why of algebraic problem solving.

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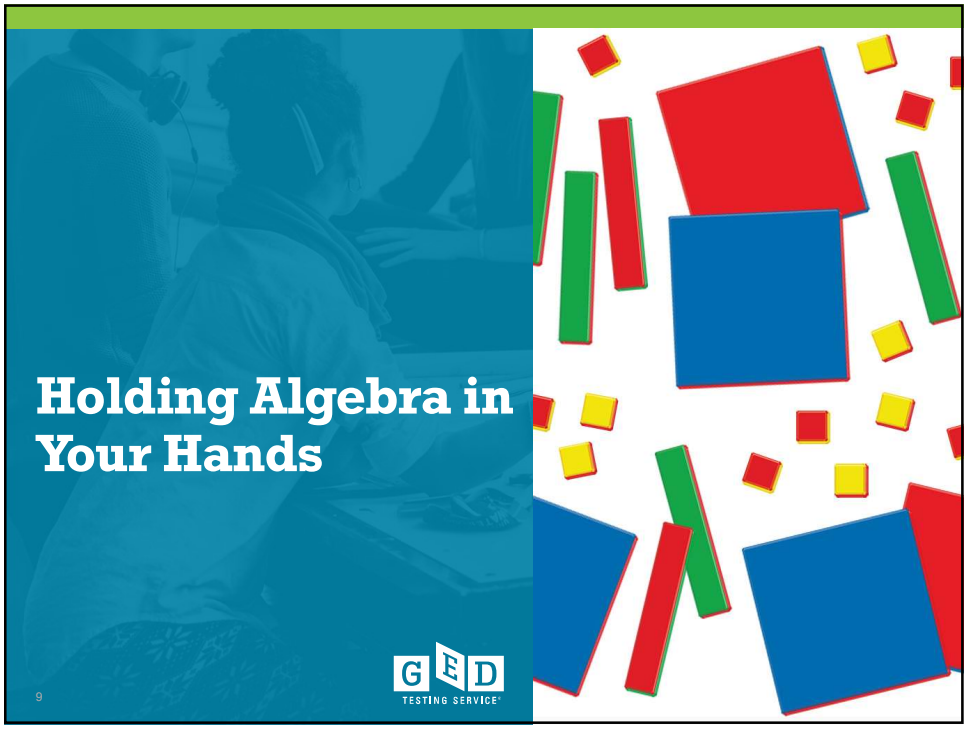

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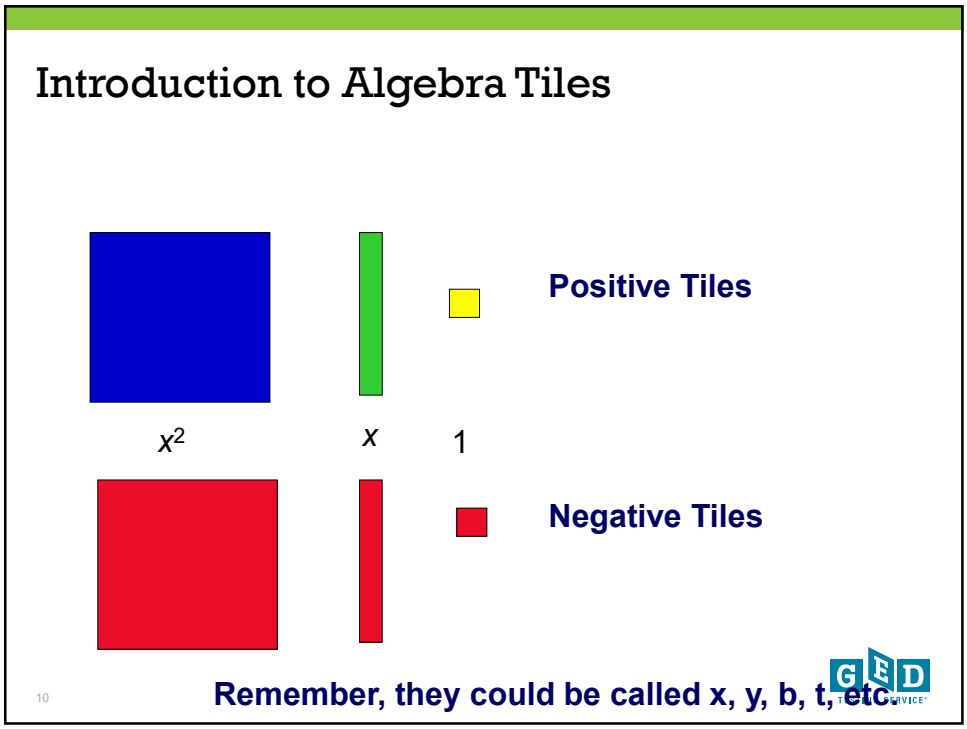

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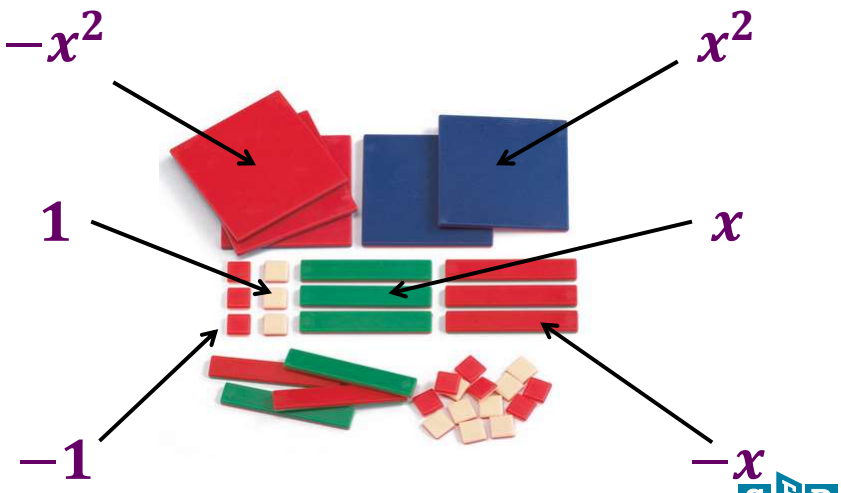
Introduction to Algebra Tiles



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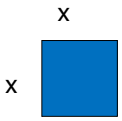
Introduction to Algebra Tiles

Each tile represents an area.



Area of large square = x (x) = x^2

Area of rectangle = 1 (x) = x

Area of small square = 1 (1) = 1

Note: Tiles are not to scale. 10 little tiles don't equal 1 big tile!

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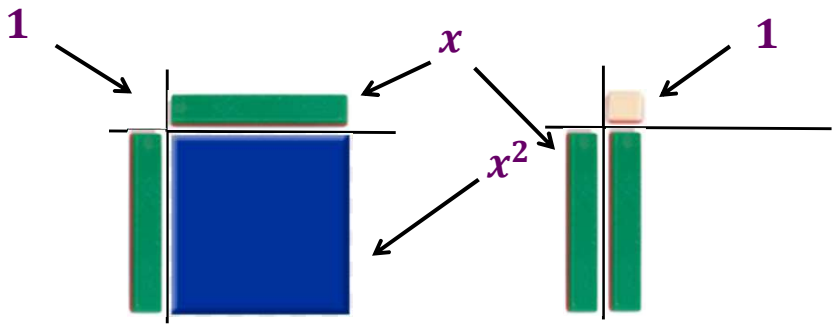
Look at the Relationships among the Tiles



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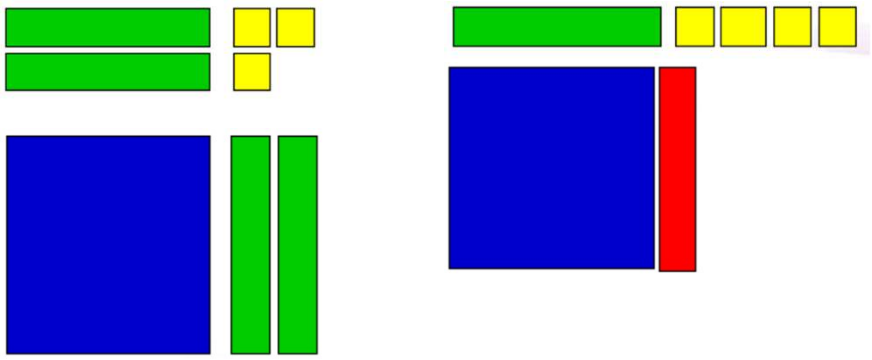
What's My Polynomial?



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Simon says show me . . .

- $2x^2$
- $- x^2$
- 3
- $2x + 3$
- $2x^2 + 6x + 5$
- $-2x^2 - 6x - 5$

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Additive Inverse (Zero Pairs)

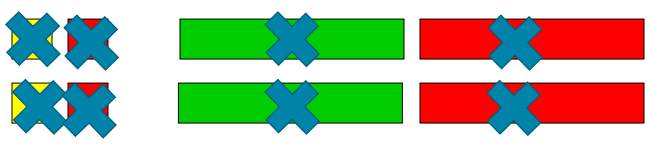
What you add to a number to get zero.
The negative of a number.

Example:
The additive inverse of −5 is +5, because −5 + 5 = 0
The additive inverse of +5 is −5, because +5 − 5 = 0

$-5 + 5 = 0$
Number — Additive Inverse

$14 + -14 = 0$
Number — Additive Inverse

Algebra Tiles – Additive Inverse



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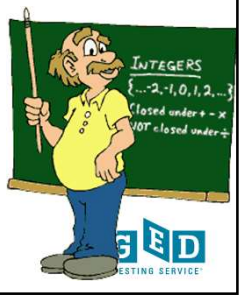
Use Algebra Tiles to Model Integer Addition

- Addition is “combining.”
- Combining involves the forming and removing of zero pairs.
- Remember, an integer is a number with no fractional part.



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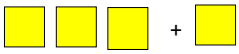
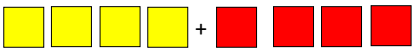
Addition of Integers

(+3) + (+1) = 

(-2) + (-1) = 

(+3) + (-1) = 

(+4) + (-4) = 

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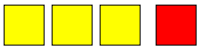
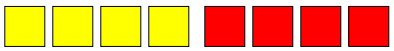
Addition of Integers

(+3) + (-1) =



(+4) + (-4) =



Don't forget that a positive and a negative "cancel" each other out!

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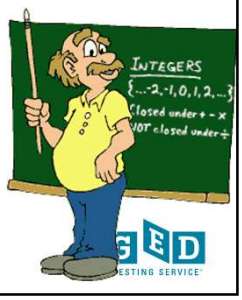
Use Algebra Tiles to Model Integer Subtraction

- Subtraction can be interpreted as "take-away."
- Subtraction can also be thought of as "adding the opposite."



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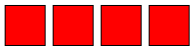
Subtraction of Integers

(+5) – (+2) =

(-4) – (-3) =



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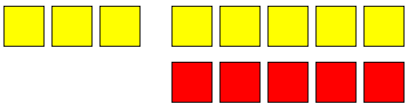
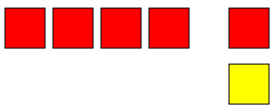
Subtracting Integers – It's Your Turn!

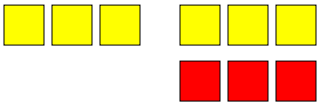
(+3) – (-5)



(-4) – (+1)



(+3) – (-3)



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Why is Understanding Additive Inverse Important?

- The additive inverse is important for understanding how to cancel terms when solving for variables in equations and formulas.
- When a number is added to its **additive inverse**, the result is zero. This is useful for getting rid of terms.

This important concept ensures that students understand the underlying concept of working with integers. Often, students rely on the old adage, "if you have two negatives change it to a positive." They have a "process," but not an understanding of how that process works.

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Combining Polynomials

Terms in an expression are like terms if they have identical variable parts.

You can combine terms that are alike.

You cannot combine terms that are unalike.

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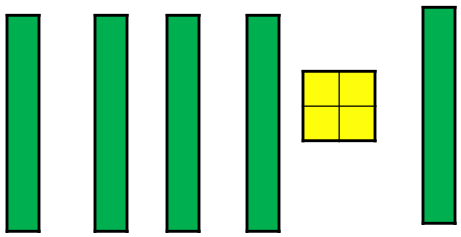
Combining Like Terms

How much do I have here?



I have 5x + 4

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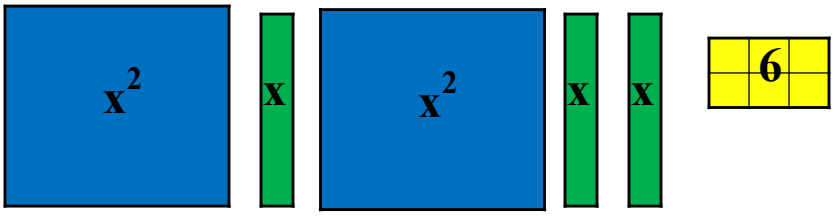
Combining Like Terms

You can only combine terms that are alike, or terms that have the same variable.



Answer: $2x^2 + 3x + 6$

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Show Me! Now Simplify!

1. $x + 3 + 2x =$ — $3x + 3$
2. $3x + 2 + x + 4 =$ — $4x + 6$
3. $2x^2 + 2x + 3 + x^2 + 1 =$ — $3x^2 + 2x + 4$
4. $-4 + 2x + 3x^2 - x - 3x =$ — $3x^2 - 2x - 4$

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Expressions and Equations

Basic Rules

1. Both sides of the equation must remain balanced.
2. Any pair of opposite signs/charges (or zero pair) cancel out, has no value, and must be taken out of the mat.

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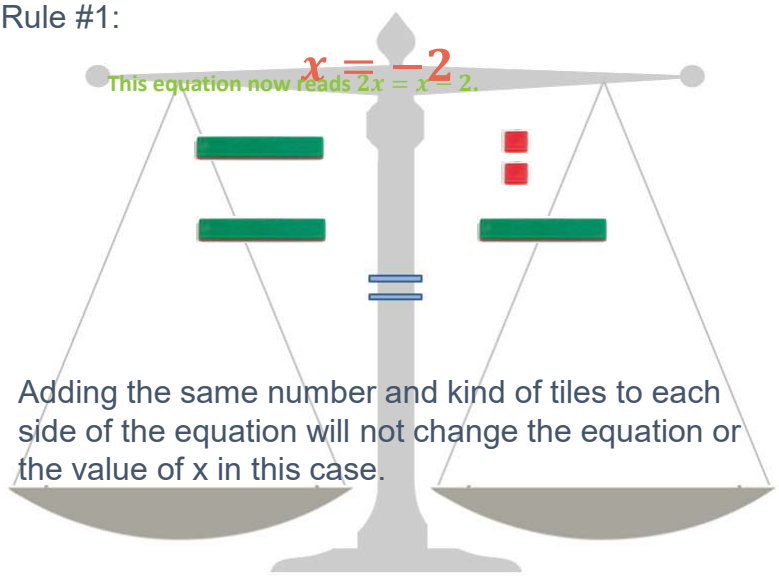
Modeling Equations

Rule #1:



Adding the same number and kind of tiles to each side of the equation will not change the equation or the value of x in this case.

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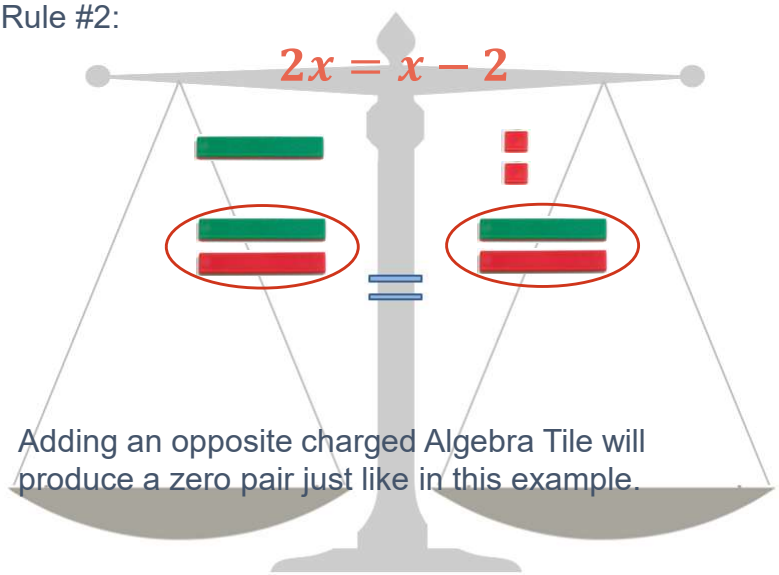
Modeling Equations

Rule #2:



Adding an opposite charged Algebra Tile will produce a zero pair just like in this example.

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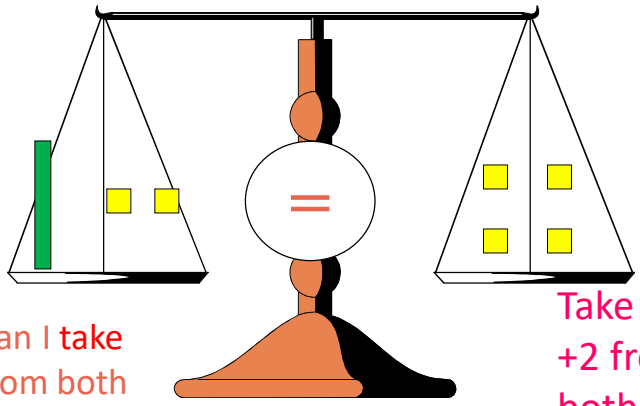
Use Algebra Tiles to Find the Value of *x*



What can I take away from both sides?

Take away +2 from both sides.

x = 2

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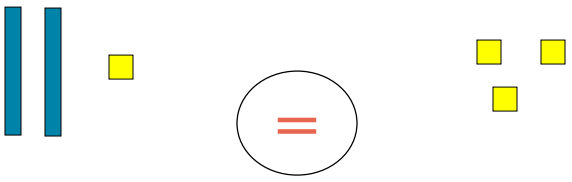
Solve for 2x + 1 = 3



What can I take away from both sides?

If 2x = 2, how do I solve?

Take away +1 from both sides.

Divide both sides in half.

x = 1

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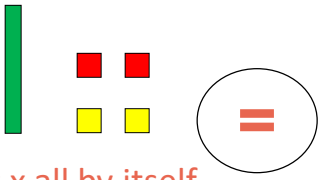
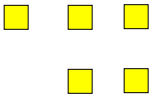
Solve for $x - 2 = 3$

They make 0 so take them away.

What happens to -2 + (+2)





I want to get x all by itself.

How do I get rid of -2 ?

Add +2 to both sides.

$x = 5$

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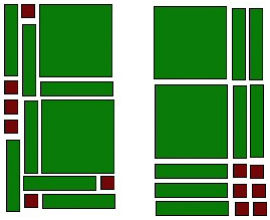
Let's Collect Tiles!

The Rules!

- Big squares can't touch little squares.
- Little squares should all be together.
- Tiles should always be in a rectangular array.

$2x^2 + 7x + 6$

Which looks best?



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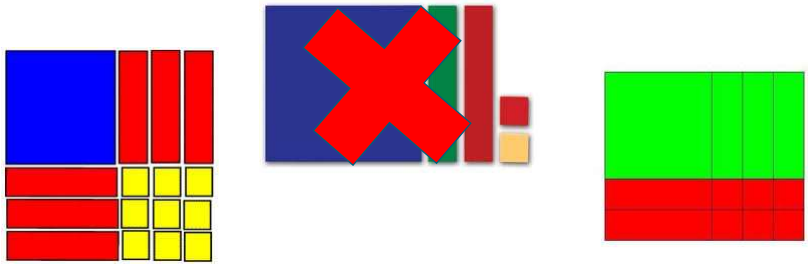
Let's Play

How many rectangular arrays do you see?



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Algebra Tiles – Time to Collect Tiles!

- $x^2 + 6x + 8$
- $x^2 – 4x + 3$
- $x^2 + 7x + 6$

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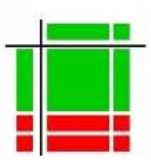
Multiplying Polynomials

It's just like figuring area!

- Place one term at the top of the grid
- Place the second term on the side of the grid
- Maintain straight lines when filling in the grid
- The inner grid is your answer!



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Let's Multiply Polynomial

$(3x)(2x) = ?$

Step 1: Gather all the tiles you need for each term.

Step 2: Lay out the tiles on opposite axes of the product mat just as shown below.

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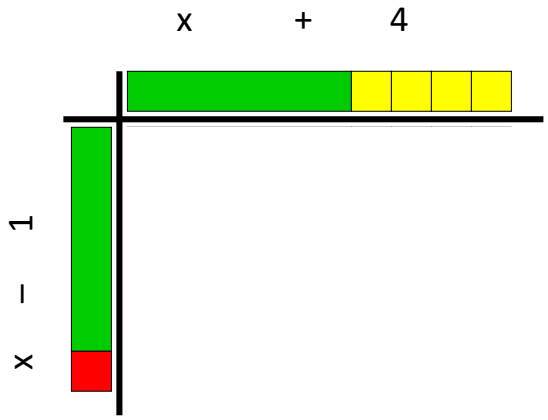
Multiplying Polynomials

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



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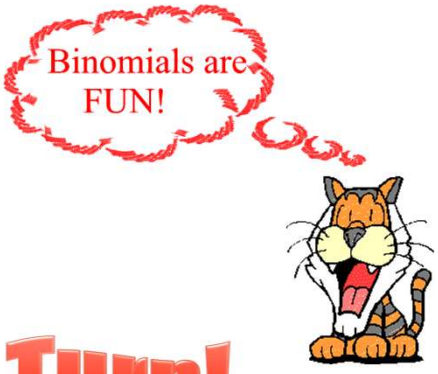
Multiplying Polynomials

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



Your Turn!

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Factoring Polynomials

- Algebra tiles can be used to factor polynomials. Use tiles and the frame to represent the problem.
- Use the tiles to fill in the array so as to form a rectangle inside the frame.
- Be prepared to use zero pairs (when needed) to fill in the array.
- Solve!

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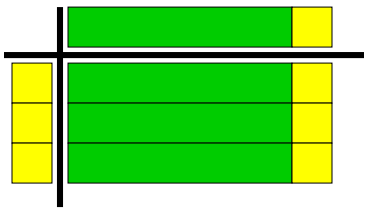
Factoring Polynomials

3x + 3 3(x+1)



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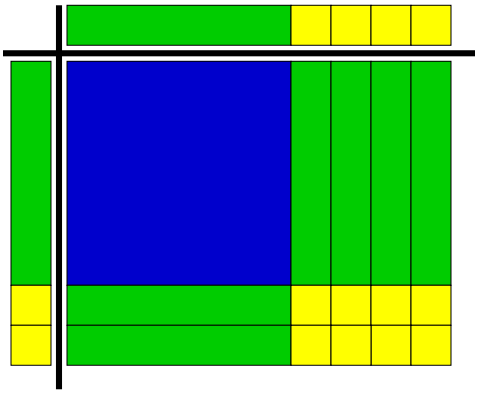
Factoring Polynomials

$x^2 + 6x + 8 =$ **(x +4) (x +2)**



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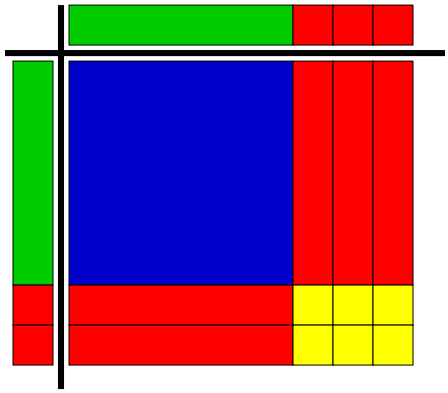
Factoring Polynomials

$x^2 – 5x + 6 =$ **(x -3) (x -2)**



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Time to Gather Up the Tiles!

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Additional Practice Activities

Factoring Polynomials Using Algebra Tiles - Del Mar College
HTTP://DMC122011.DELMAR.EDU/MATH/MLC/QEPMATHSEMINARS/FACTORINGTRINOMIALSALGEBRATILESSTUDENTACTIVITY.PDF

Multiplying Polynomials Using Algebra Tiles – Virginia Dept. of Education
Mathematics Enhanced Scope and Sequence – Algebra I
http://www.doe.virginia.gov/testing/solsearch/sol/math/A/m_ess_a-2b_2.pdf

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The Algebra Tiles Web App

NCTM ILLUMINATIONS Resources for Teaching Math

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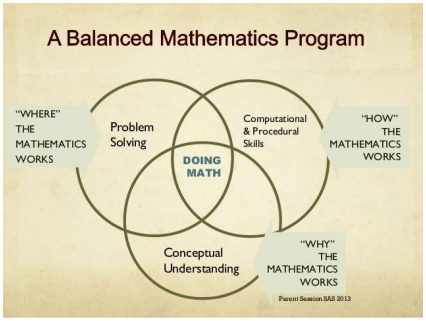
Our Students Need…



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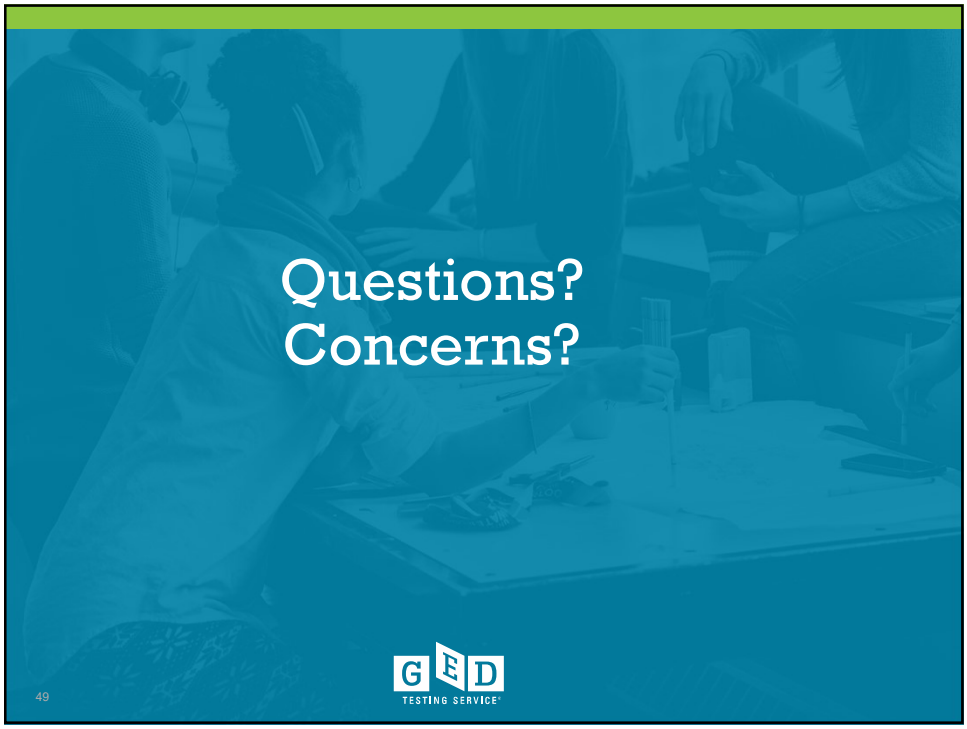

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