LESSON PLAN

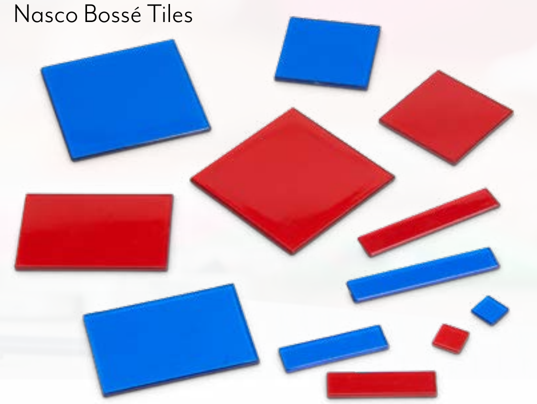
mathworks

ADDITION WITH ALGEBRA TILES

Volume 40

Developed with Kristin Ulrich
Grades 4-8

Nasco Bossé Tiles



Content

Algebra tiles are a great way to provide students with a concrete representation of some very abstract concepts. The introduction of this lesson focuses on familiarizing students with the function of algebra tiles. In Activity 1, students will first use the tiles to illustrate a variety of expressions, such as $3x + 5$ and $2x - 4$.

Once they have mastered an understanding of how to build such expressions, they will move on to Activity 2 where they will learn how to solve addition problems, such as $(3x + 5) + (2x - 4)$ using the algebra tiles.

Activity 2 has three tiers of complexity. The first tier includes equations that only involve addition of positive numbers such as $(x + 2) + (2x + 1) = 3x + 3$. The second tier includes equations that involve an understanding of negative integers such as $(x - 2) + (2x + 5) = 3x + 3$. The third tier includes additional understanding of negative integers when they are used as coefficients such as $(-4x + 5) + (3x - 8) = -x - 3$

Once students have had the opportunity to practice problems in the tier(s) that best fit their needs, additional practice is included in both worksheet and game form.

Prior to this lesson, students should have a working understanding that subtraction is the opposite of addition.

Materials needed are listed on the next page.

Common Core State Standards

CCSS.MATH.CONTENT.5.OA.A.1 — Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.
CCSS.MATH.CONTENT.6.EE.A.2 — Write, read, and evaluate expressions in which letters stand for numbers.
CCSS.MATH.CONTENT.7.EE.A.1 — Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

MATERIALS

- Nasco Bossé Tiles
  X and Y Class Set **(TB24441)**
  X and Y Student Set **(TB24571)**
  X, Y, and Z Student Set **(TB24570)**
- Algebra Tiles™
  Student Set **(TB15453)**
  Classroom Kit **(TB17249)**
- Foam Algebra Tiles™
  Student Set **(TB20570)**
  Classroom Set **(TB21935)**

Included with lesson:

- Equation sheet
- Expression Practice worksheet
- Tier 1 Equation Practice worksheet
- Tiers 1–3 Equation Practice worksheet
- Bingo sheet
- Tier 1 Bingo Expressions
- Tier 2 and 3 Bingo Equations

Will need: 10 blue unit tiles, 10 red unit tiles, and 10 blue *x* tiles per student

Note: If using Algebra Tiles™ with this lesson plan, the colors are not just blue and red to denote positive or negative numbers.

INTRODUCTION (20 MINUTES):

1. If students are not familiar with the term **expression**, explain that it is a combination of numbers and variables using operations.
2. Provide these two examples of expressions.

$x + 3$	$2x – 1$

3. Have students talk with a neighbor. Ask them to determine the numbers, variables, and operations present in each expression. Additionally, have them discuss how expressions are similar to and different than equations.
4. Reconvene and ask a few pairs to discuss their findings. Be sure students acknowledge there is an unwritten "1" before the **variable** in $x + 3$. Additionally, if students do not bring it up themselves, explain there are two terms in each expression you'll be working with today. There is one term that includes a variable before the operation sign and one term that includes the units after the operation sign. The number before the variable is called the **coefficient**. Sometimes it's written out, like in $2x – 1$. In this expression, the coefficient is 2. Other times, the coefficient is an unwritten 1, like in $x + 3$. Some expressions, like these two examples, include a term without a variable. The term without a variable is called a **constant**.

Here are two sample responses to the equation/expression comparison.

Similarity: Both equations and expressions include numbers and operations.
Difference: Equations include an equal sign while expressions do not.

5. Split the class into two groups (boys/girls, students wearing sneakers/non-sneakers, etc.). You'll want to have close to an equal number of students in each group.
6. Put a large addition sign on the board. Put one group of student to the left of the + sign and the other group of students to the right.
7. Explain that the group on the left is the **variable group**. They'll represent the *x* term. The group on the right is the **number group**. They'll represent the unit term or constant in each expression.
8. Students will physically "create" each expression you read by having the correct amount of variables and numbers step forward to represent the provided expression.
9. Read each expression aloud and ask students to create it.

$4x + 3$	$2x + 7$	$8x + 5$
$7x + 7$	$10x + 10$	$5x$

Possible Intervention: Students may not understand why $5x$ is an expression. Explain that this expression has a number (5) and a variable (x). The operation is the number being multiplied by the variable.

10. Change the + sign on the board to a – sign. Explain to students you'll follow the same procedure, but this time, you'll be creating subtraction expressions.

Since students have already had a variety of opportunities to physically create expressions in Step 9, there are intentionally less practice expressions here. If students need additional practice, create additional expressions for more practice in this section.

$2x – 8$	$7x – 1$	$8x – 8$

ACTIVITY 1:

Prior to the activity, make sure each student has 10 *x* tiles, 10 blue unit tiles, and 10 red unit tiles

1. Explain to students the algebra tiles in front of them will work in a similar fashion to the way they created equations in the introduction. The small rectangle bars represent the variable, *x*. The blue unit square tiles represent positive integers and the red square tiles represent negative integers.

   For students not familiar with positive and negative integers, simply state the blue unit tiles are used in addition expressions and the red unit tiles are used in subtraction expressions.

2. Model for students (have them build along with you) how to use the tiles to create the expression $4x + 7$

   Use think aloud language, such as that below, to model for students how to represent an expression in algebra tiles.

   I notice the coefficient or number in front of the variable is 4. That number tells me I need 4 *x* tiles. I also notice the number 7 after the addition sign. I also notice the addition sign in my expression which tells me I'll need to use blue unit tiles. The number 7 tells me I'll need exactly 7 blue unit tiles. Those tiles represent the constant in my expression.

3. Use the same think aloud language to model for students how to create the subtraction expression $8x – 3$. Have students continue to make their own algebra tile expressions as you model for them.

Intervention: If needed, work together to make additional expressions such as $x – 8$ and $3x + 5$. Model the same think aloud language as you go through those additional expressions.

Extension: Have two students combine their total algebra tiles. Ask pairs to create expressions that include larger numbers such as $14x – 18$ or $17x + 12$.

4. Use algebra tiles to create the expression $5x + 7$. Explain that in the previous examples you started with an expression and determined how to represent that expression using algebra tiles. Now, you're going to show students how to determine an expression based on the algebra tile representation. Use think aloud language, such as that below, to model for students how to determine the expression represented by a given set of tiles.

   I know that the small rectangular tiles represent the value of x for the expression. There are 1, 2, 3, 4, 5 blue rectangles, the expression starts with 5*x*. I also see some blue square unit tiles. Since they're blue, I know this is an addition problem. I notice there are 7 tiles, so my expression is 5*x* + 7.

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5. Create the subtraction expression $2x - 3$. Use the same think aloud language.

I know that the small rectangular tiles represent the value of *x* for the expression. There are 1, 2 blue rectangles, so the expression starts with $2x$. I also see some red square unit tiles. Since they're red, I know this is a subtraction expression. I notice there are 3 unit tiles, so my expression is $2x - 3$.

Intervention: Work together to make additional tile models such as $4x - 4$ and $7x + 9$. Model the same think aloud language as you work through additional algebra tile examples.

Extension: Place students in pairs and ask them to create their own expressions. Student 1 uses tiles to build the expression and Student 2 determines the expression. Students can switch roles.

6. Distribute the Expression Practice worksheet. To check for understanding, work through 1 to 2 problems together in each section of the worksheet.

Check for Understanding:

Part A: Problem 1

1. What do the rectangular tiles represent?
   (the value of *x* or the coefficient)
2. How many rectangular tiles are in the illustration? (5)
3. Is this an addition or subtraction problem? (addition)
4. How do you know? (the square tiles are blue)
5. What do the square tiles represent? (units or the constant)
6. How many square tiles are in the illustration? (1)
7. What is the expression represented by the tiles? ($5x + 1$)

Part B: Problem 1

1. What is the coefficient in the first term? (3)
2. What does that coefficient tell you?
   (I need three *x* rectangular tiles.)
3. How many unit tiles are needed? (6)
4. What color should the unit tiles be? (They should be blue because this expression includes addition)

ACTIVITY 2: ADDING EXPRESSIONS

Tier 1: Adding two expressions that use addition only

Prior to this activity, put students together in groups of two so each pair of students has access to 20 *x* and 20 blue tiles. If working through Tier 3, each pair will also need 20 red *x* tiles and 20 red unit tiles. Be sure each pair of students also has an Equation Sheet for each problem discussed in Tiers 1, 2, and 3.

1. Ask students to help you use algebra tiles to create the expression $4x + 5$. If needed, use the same think aloud process you used in Step 2 of Activity 1. Put the expression in the top box of the Equation sheet.

2. Along with students, build the expression $2x + 3$. That expression should be built in the second box of the Equation sheet

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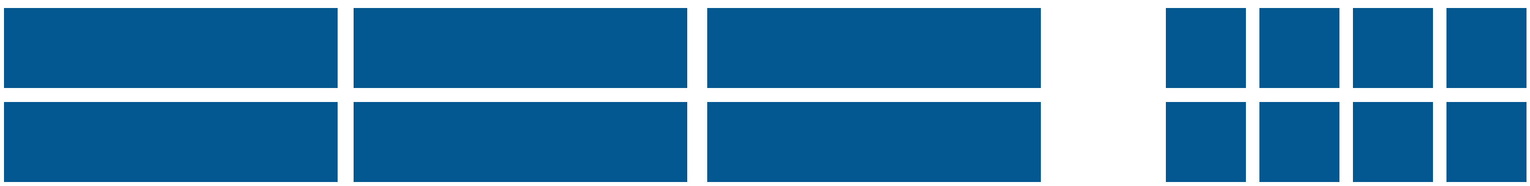
3. Tell students you've just built two expressions in the same manner as you did in Activity 1. Now you'll add another layer because you will add the two expressions together to solve an algebraic equation.

4. In order to solve the equation, explain you'll need to combine the like terms in each expression. First, add together all of the x tiles. You know they're like terms because the tiles are identical in size and shape. Since they are all x tiles, the variable remains the same while the coefficients (4 and 2) are added together to have $6x$ in all. Build $6x$ below the equation line.

5. Do the same with the constants. Add 5 + 3. Build 8 below the equation line.

6. Write the entire equation out for students to see. $(4x + 5) + (2x + 3) = 6x + 8$



7. Ask students to make observations about the relationship between the expressions.

   Sample responses could include noticing the coefficients are added while the variable remains the same and noticing the constants are added just as they would be in a basic addition problem.

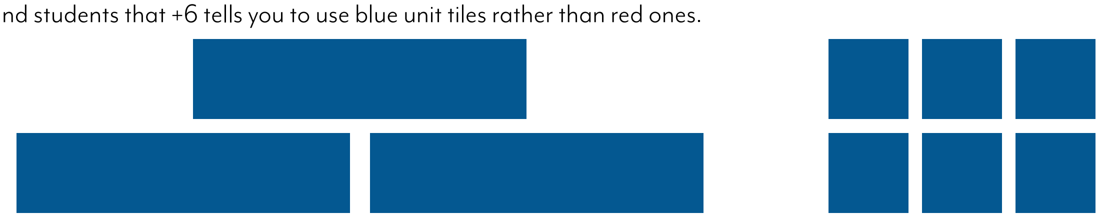
8. Work together with students to create additional equations such as $(x + 3) + (7x + 7)$ or $(2x + 9) + (3x + 5)$.

9. If this is as far as students are going with the lesson, continue with the provided Tier 1 Bingo game and/or the Tier 1 Equation worksheet.

Tier 2: Expression that include negative integers

1. Use algebra tiles to build $(4x – 8)$. Ask students to build the expression along with you. If needed, use the think aloud strategy used in Activity 1. Remind students that -8 tells you to use red unit tiles rather than blue ones.

2. Use algebra tiles to build $(3x + 6)$ after the addition sign. Ask students to build the expression along with you. Use the think aloud strategy as needed. Remind students that +6 tells you to use blue unit tiles rather than red ones.



3. Remind students to solve the equation you'll need to combine the like terms in each expression. Explain that ($4x$ and $3x$) are like terms and (-8 and 6) are also like terms.

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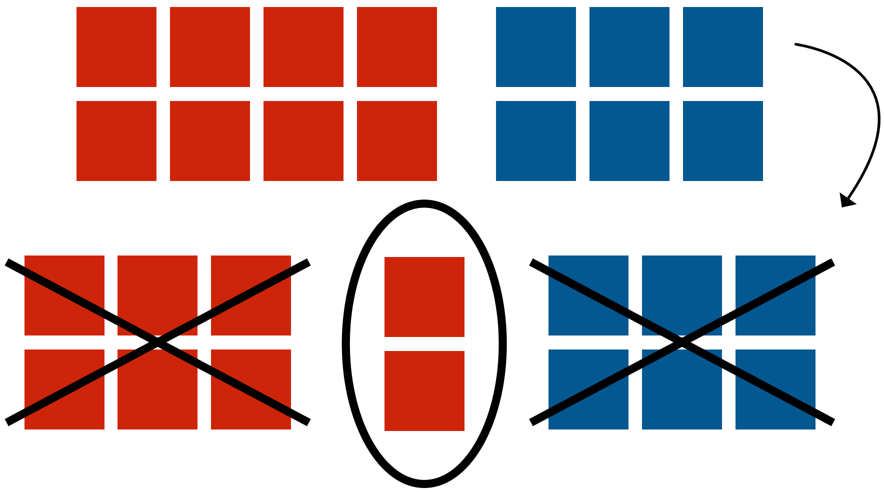
Possible Intervention: Students may have trouble understanding why -8 and 6 are like terms when their tiles are different colors. Remind students they are both integers without a variable attached to them, so they are both a constant. Since they're both constants, they're like terms. Another way to explain is that they both use the same size and shape tile, so they're like terms. The color of the tiles doesn't matter. The shape and size of the tiles does matter.

4. Now that the equation is set up, solve for x first. Tell students that since the tiles are the same color, all that needs to be done is add the two together for a total. What is the total number of blue x tiles? (7)

5. Put $7x$ in the answer box of the equation sheet.

6. Ask students what they notice about tiles that represent the two constants (they're different colors). Explain that since they're different colors they can't simply be added together like they were when you added the coefficients of the x terms.

7. Show students how to remove pairs of unit tiles (1 red and 1 blue) until no pairs remain.



8. Ask students to identify what remains when all pairs are removed (2 red tiles). Ask what the 2 red tiles represent (-2).

9. Explain the final answer for the equation is $7x - 2$.

10. For further practice, follow the same steps for problems like $(5x + 4) + (5x - 2)$ and $(6x - 1) + (x + 6)$.

11. Follow the same steps to solve $(6x - 4) + (2x - 5)$. Show students that solving for the x tiles remains the same.

12. Explain that since all of the unit tiles are red, no pairs can be removed like in the previous examples. Instead, students will treat this like the Tier 1 problems. All the unit tiles need to be added together (9). Since they're negative, they represent -9.

13. The final answer for this equation is $8x - 9$.

14. Provide additional practice of the same kind with problems like $(3x - 6) + (x - 2)$ and $(7x - 5) + (4x - 5)$.

Tier 3 Problems: Equations that include expressions with negative variables and integers

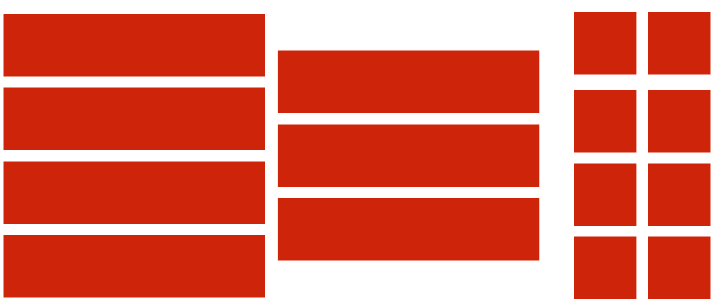
1. Show students that the same steps can be followed to solve equations that include expressions such as $-6x - 6$ that include negative variables.

2. To build $-6x - 6$, simply show students they can use six red *x* tiles to represent the $-6x$ and six red unit tiles to represent the -6. Put the algebra tile representation in the top box of the Equation worksheet.

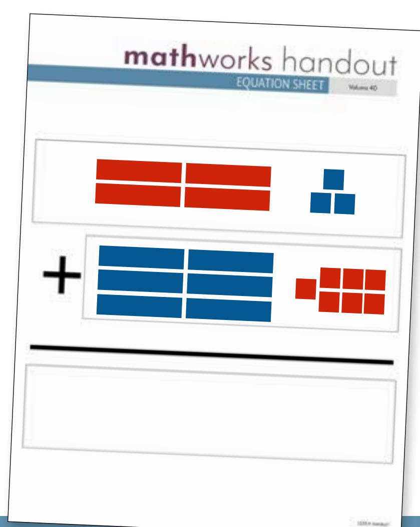
3. Similarly, ask students to build $-x - 2$. Model that they'll need one red *x* tile and 2 red unit tiles. Put the representation in the second box of the Equation worksheet.

4. Since all of the *x* tiles are red, they simply need to be combined to represent the $-7x$ in the equation's answer. Since all of the unit tiles are also red, they too need to be combined to represent the -8 in the equation's answer.

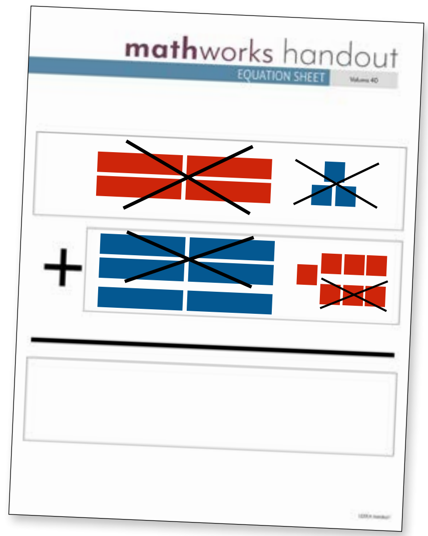
$$(-6x - 6) + (-x - 2) = -7x - 8$$



5. Just like in Tier 2, there can be a combination of positive and negative integers used. Guide students through solving $(-4x + 3) + (8x - 7)$. Have them work as independently as possible to build each expression and place them in the correct boxes of the Equation worksheet.



6. Ask students what they notice about the *x* tiles? (Box 1 includes red *x* tiles and box 2 includes blue *x* tiles). Remind students that they will need to remove pairs until there are no pairs of tiles left to remove. Tell them that pairs of tiles must be of opposite color, but must be matching in size. The *x* tiles can only pair with opposite colored *x* tiles and unit tiles can only pair with opposite colored unit tiles.



7. Ask students to use what is left over to help them determine the answer to the equation. Since 2 blue *x* tiles and 4 red unit tiles remain, the answer to this equation is $2x - 4$.

8. Provide students with additional practice using problems like $(5x - 9) + (-4x + 3)$ and $(-x + 3) + (-2x - 7)$.

9. Conclude the lesson with the Tier 1-3 Bingo game and/or the Tier 1-3 Equation worksheet.

Extension: Use algebra tiles to create an expression like $4x + 7$ or $-x + 4$. Ask students to come up with two expressions that would be addends for an equation with the expression you created as the answer.

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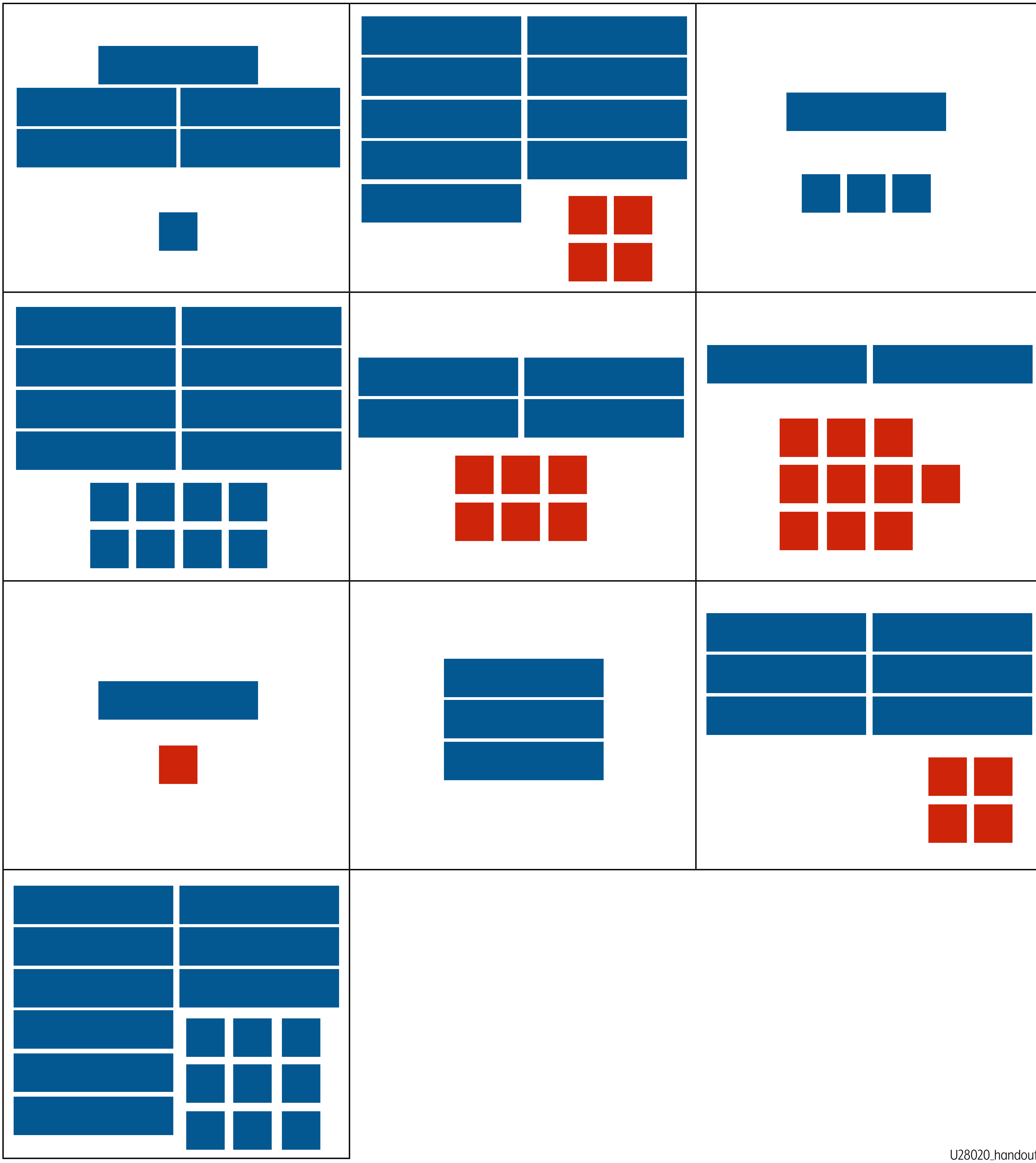
EXPRESSION PRACTICE WORKSHEET – PART A

Volume 40

Part A: Write the expression that is represented by each set of tiles.



EXPRESSION PRACTICE WORKSHEET – PART B

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Part B: Draw the tiles that correctly represent each expression.

$3x - 6$	$x + 4$	$2x + 5$
$4x - 2$	$7x + 8$	$9x$
$8x + 1$	$x - 5$	$6x - 3$

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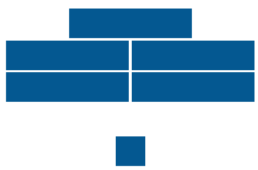
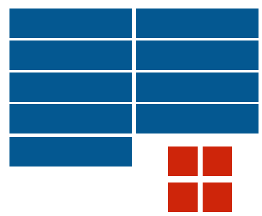
EXPRESSION PRACTICE WORKSHEET – ANSWER KEY

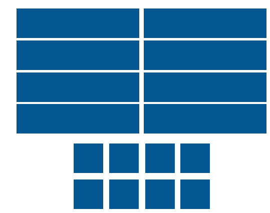
Volume 40

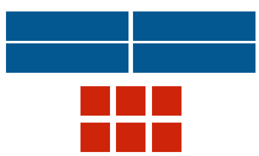
Part A: Write the expression that is represented by each set of tiles.

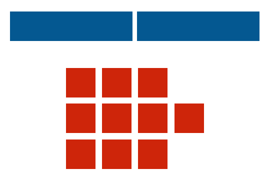

$5x + 1$


$9x - 4$


$x + 3$

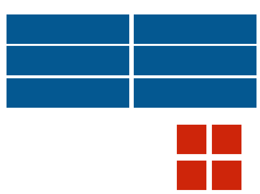

$8x + 8$

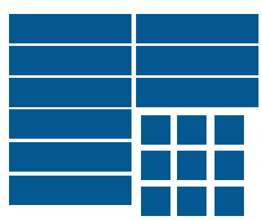

$4x - 6$


$2x - 10$


$x - 1$


$3x$


$6x - 4$


$9x + 9$

Part B: Draw the tiles that correctly represent each expression.

$3x - 6$

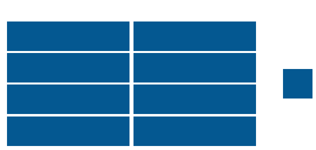

$x + 4$


$2x + 5$


$4x - 2$


$7x + 8$


$9x$


$8x + 1$


$x - 5$


$6x - 3$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TIER 1 EQUATION WORKSHEET

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Use algebra tiles to build each equation. Draw the algebra tiles that represent each part of the equation.

1. $(3x + 8) + (3x + 1) =$ __________

	+	=

2. $(x + 4) + (6x + 2) =$ __________

	+	=

3. $(8x + 7) + (5x + 11) =$ __________

	+	=

4. $(12x + 2) + (7x + 9) =$ __________

	+	=

5. $(3x) + (8x + 5) =$ __________

	+	=

6. $(4x + 7) + (13x + 8) =$ __________

	+	=

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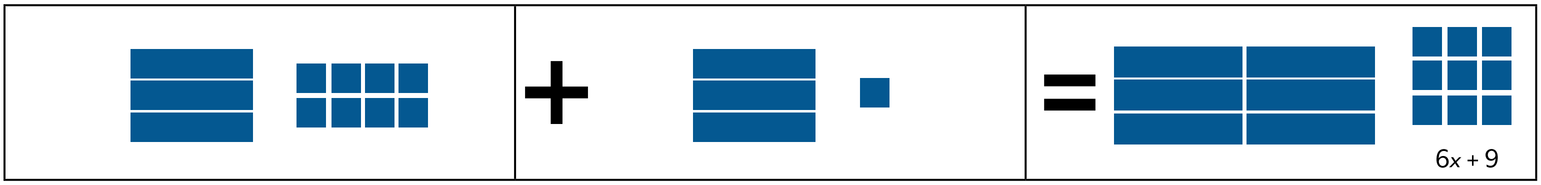
TIER 1 EQUATION WORKSHEET – ANSWER KEY

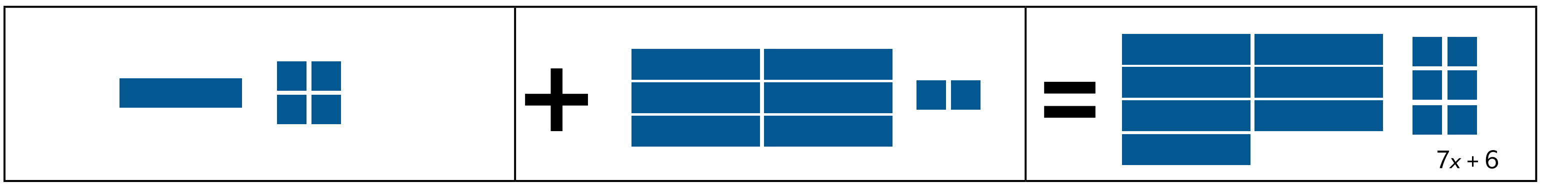
Volume 40

Use algebra tiles to build each equation. Draw the algebra tiles that represent each part of the equation.

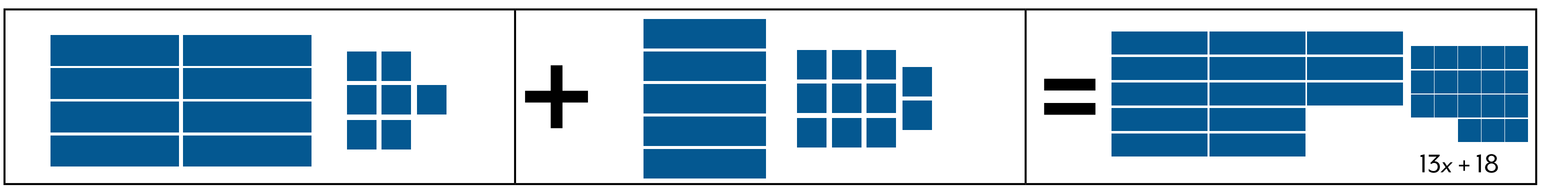
1. $(3x + 8) + (3x + 1) =$ $\underline{6x + 9}$



2. $(x + 4) + (6x + 2) =$ $\underline{7x + 6}$

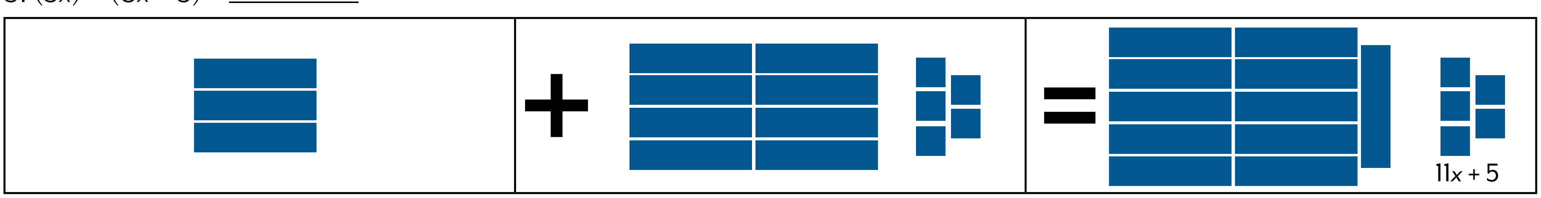


3. $(8x + 7) + (5x + 11) =$ $\underline{13x + 18}$

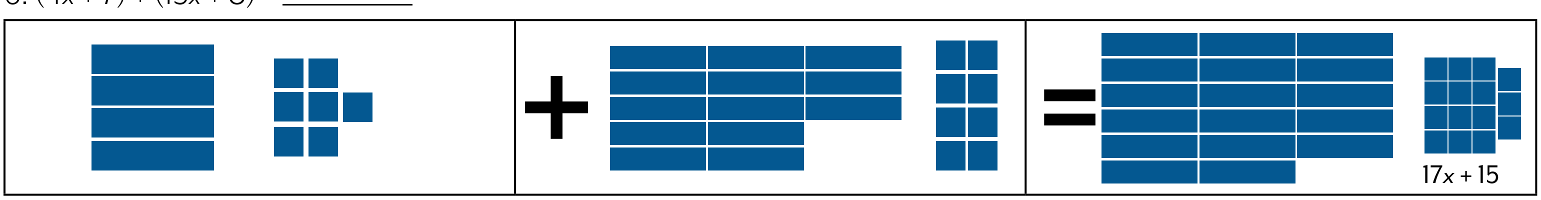


4. $(12x + 2) + (7x + 9) =$ $\underline{19x + 11}$

5. $(3x) + (8x + 5) =$ $\underline{11x + 5}$



6. $(4x + 7) + (13x + 8) =$ $\underline{17x + 15}$



Use algebra tiles to build each equation. Draw the algebra tiles that represent each part of the equation.

1. $(5x - 3) + (4x - 5) =$ ________

	+	=

2. $(-3x + 4) + (6x + 7) =$ ________

	+	=

3. $(2x + 3) + (4x - 9) =$ ________

	+	=

4. $(-5x + 3) + (-2x - 6) =$ ________

	+	=

5. $(7x + 1) + (x - 9) =$ ________

	+	=

6. $(x + 7) + (-5x - 3) =$ ________

	+	=

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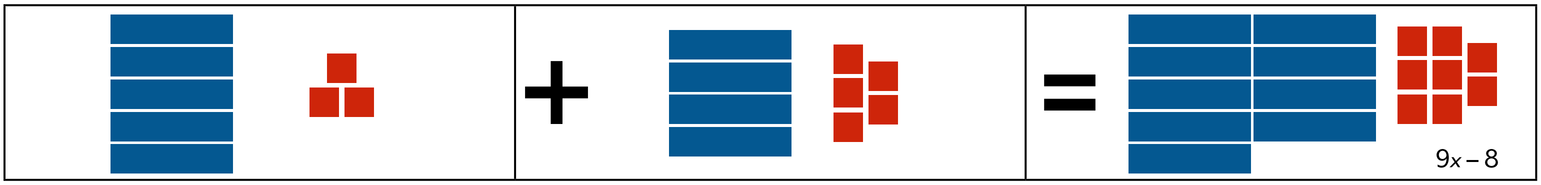
TIER 1-3 PRACTICE WORKSHEET – ANSWER KEY

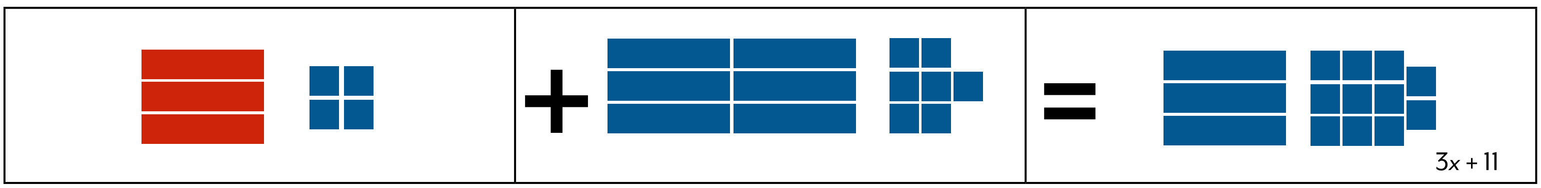
Volume 40

Use algebra tiles to build each equation. Draw the algebra tiles that represent each part of the equation.

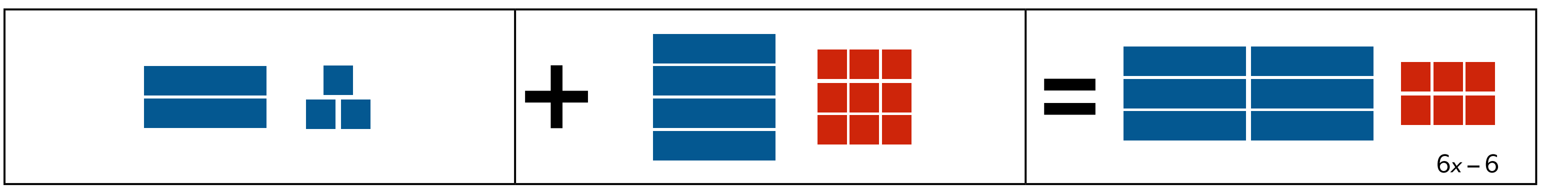
1. $(5x - 3) + (4x - 5) =$ $9x - 8$



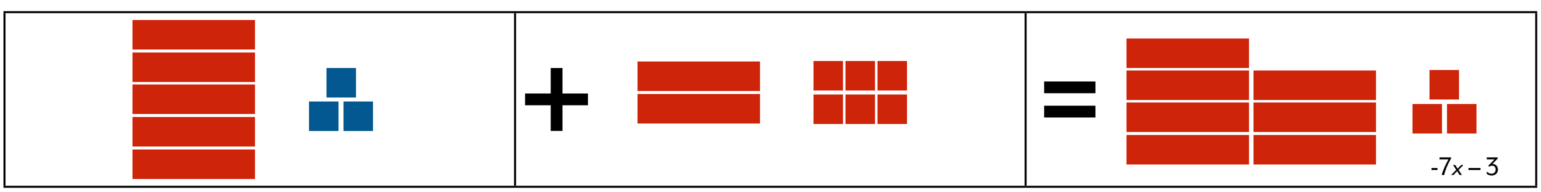
2. $(-3x + 4) + (6x + 7) =$ $3x + 11$



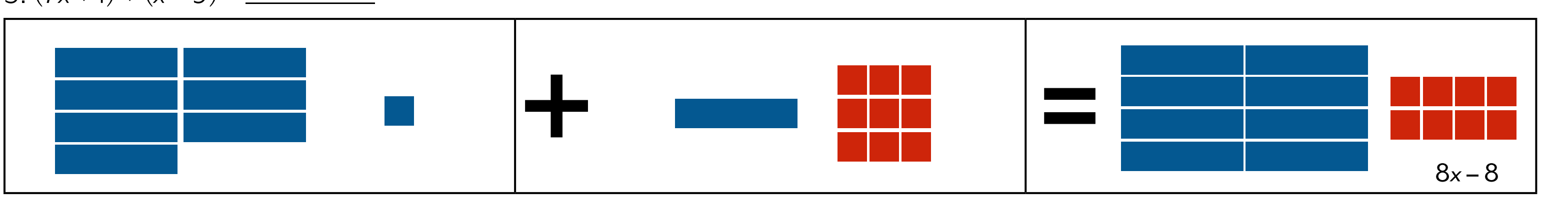
3. $(2x + 3) + (4x - 9) =$ $6x - 6$



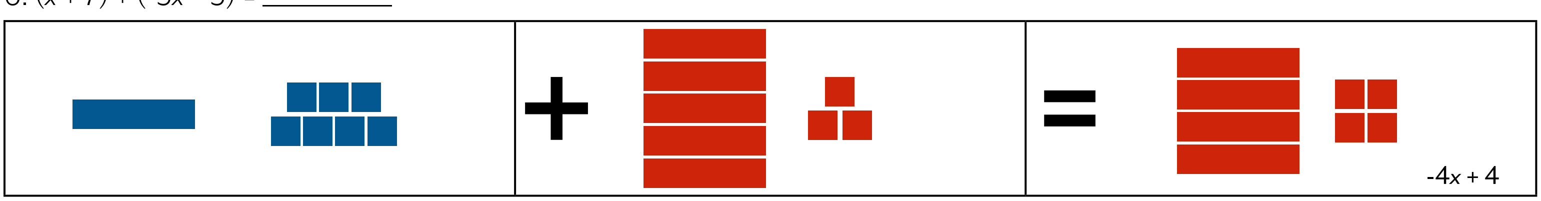
4. $(-5x + 3) + (-2x - 6) =$ $-7x - 3$



5. $(7x + 1) + (x - 9) =$ $8x - 8$



6. $(x + 7) + (-5x - 3) =$ $-4x + 4$



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TIER I BINGO EXPRESSIONS

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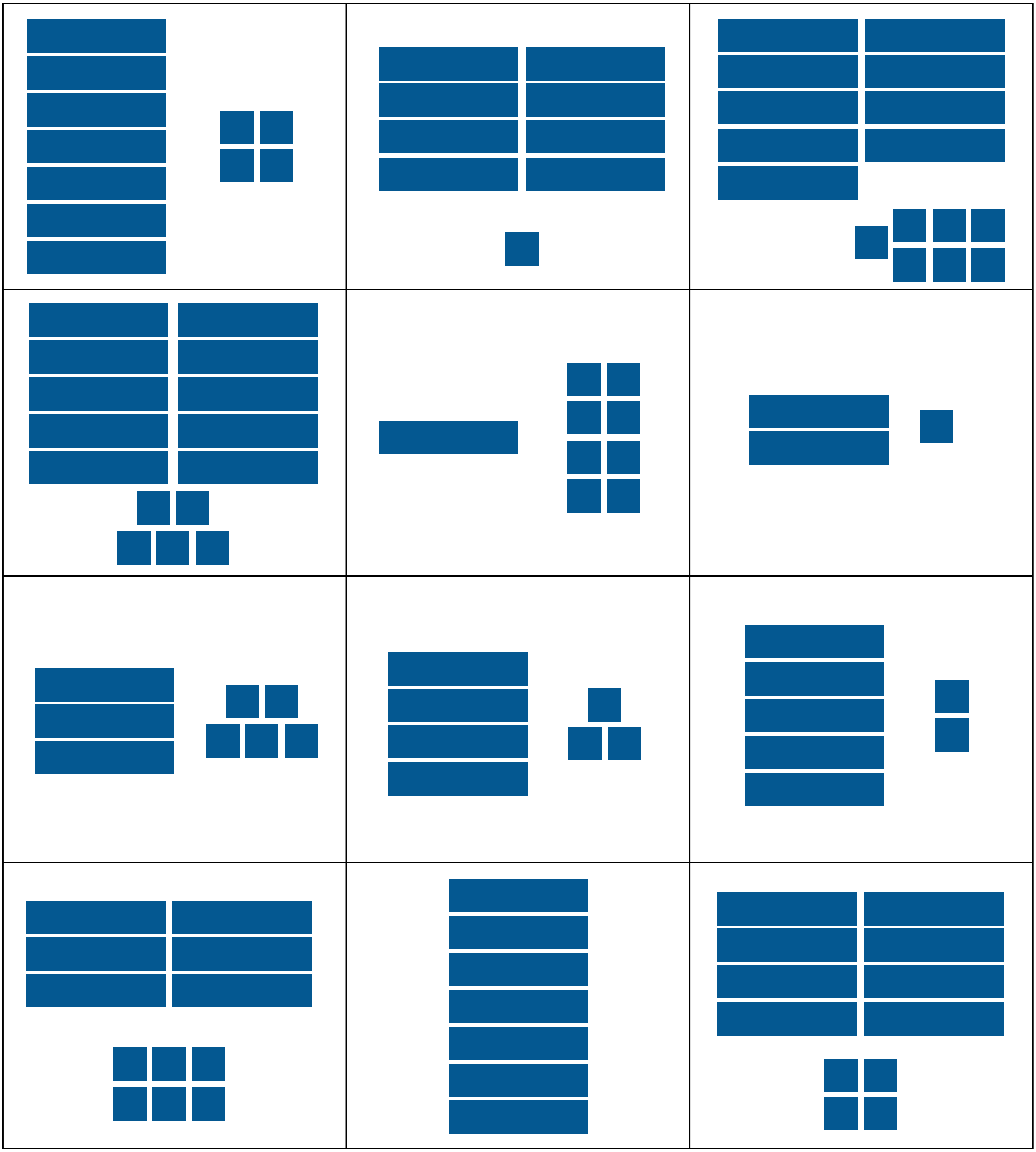
Have students write one expression in each open space of their bingo cards.

$x + 1$	$2x + 3$	$3x + 8$	$4x + 7$	$5x + 3$	$6x + 8$
$7x + 4$	$8x + 1$	$9x + 7$	$10x + 5$	$x + 8$	$2x + 1$
$3x + 5$	$4x + 3$	$5x + 2$	$6x + 6$	$7x$	$8x + 4$
$9x + 3$	$10x + 2$	$x + 5$	$2x$	$3x + 3$	$4x + 5$

Show students the algebra tile cards one at a time. Have them cross off the expression that corresponds with the card.

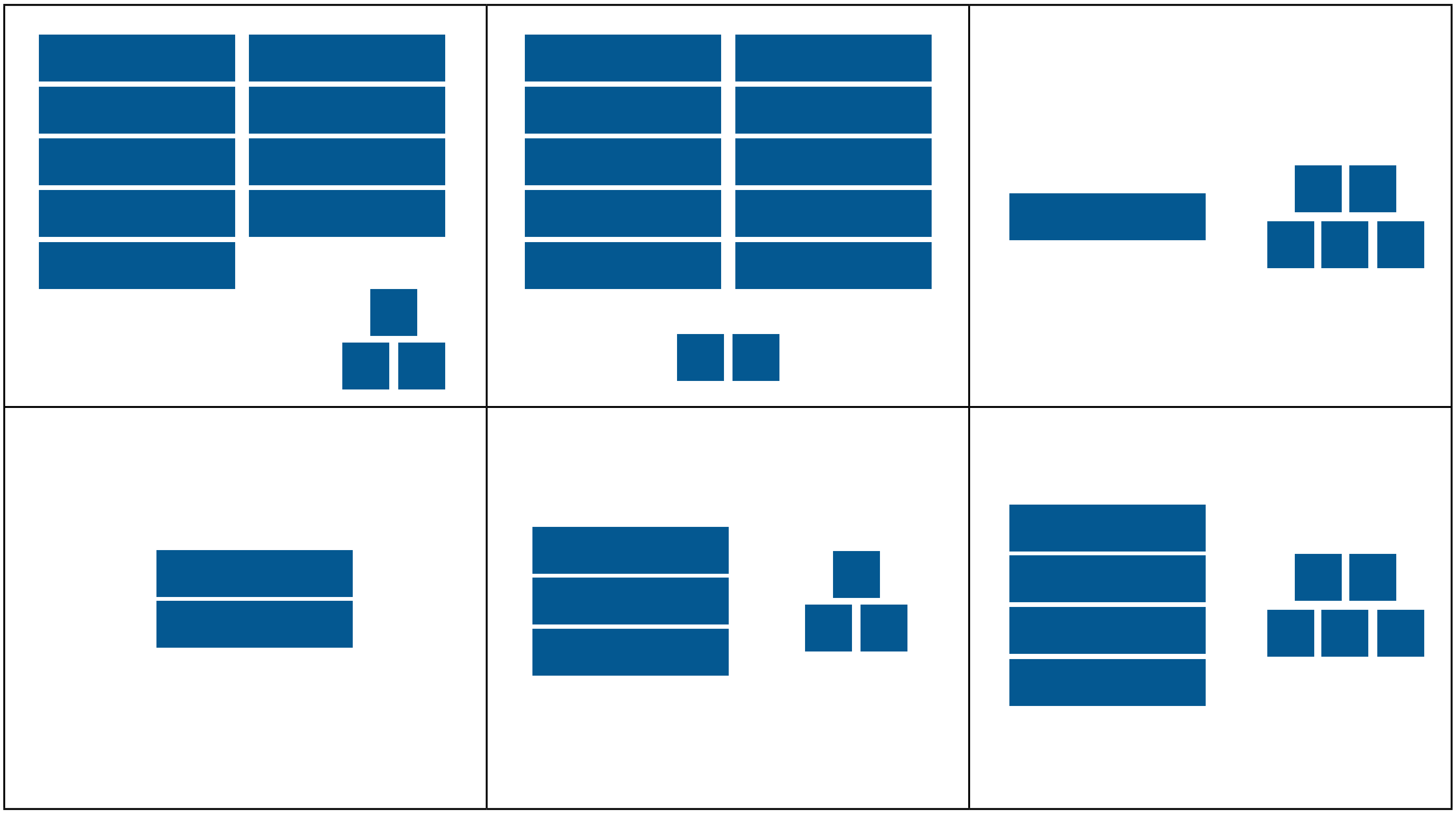
Cards cont. on next page

Tier 1 - Algebra Tile Cards cont.



Cards cont. on next page

Tier 1 - Algebra Tile Cards cont.



mathworks handout

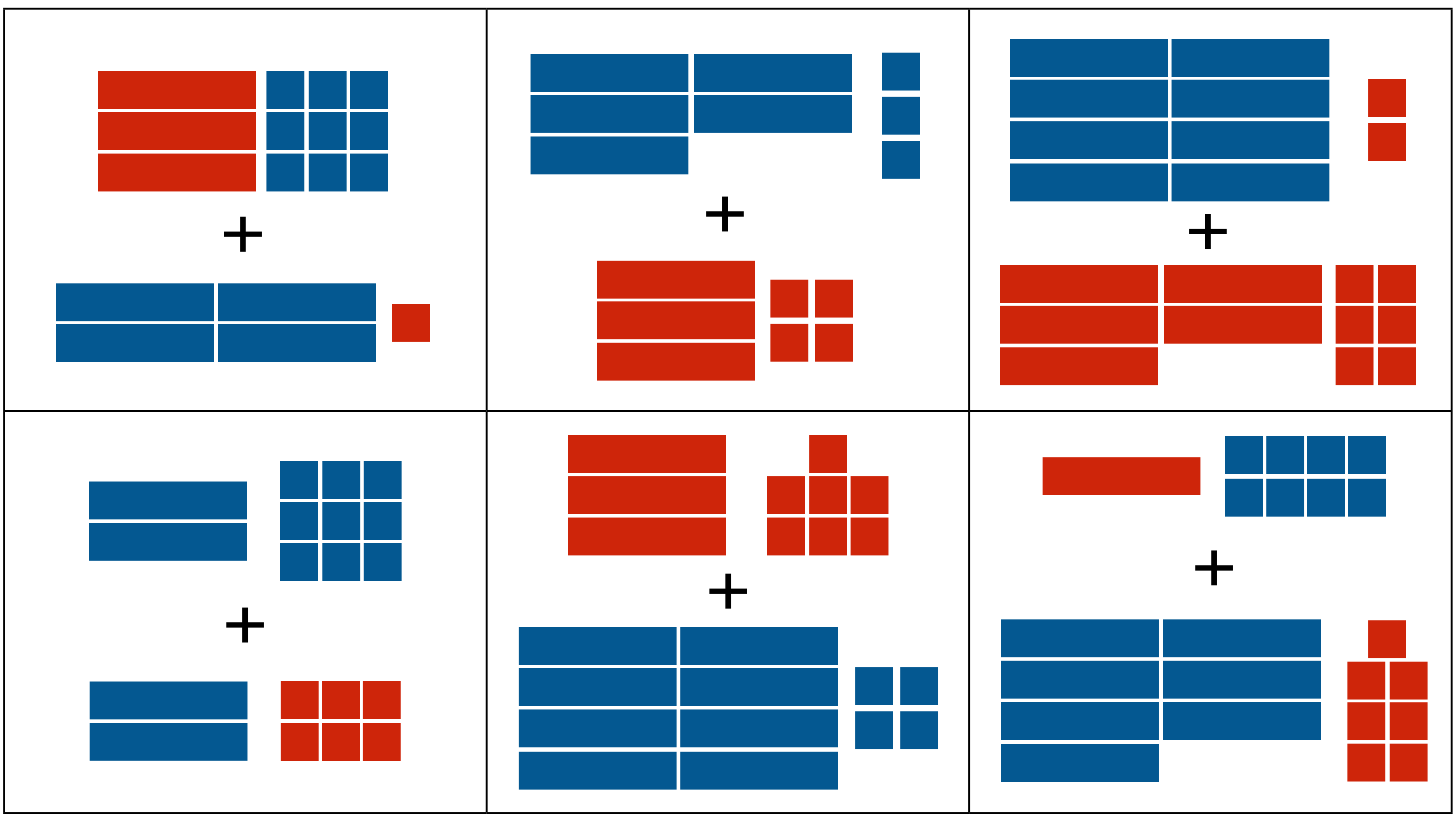
TIER 2-3 BINGO EXPRESSIONS

Volume 40

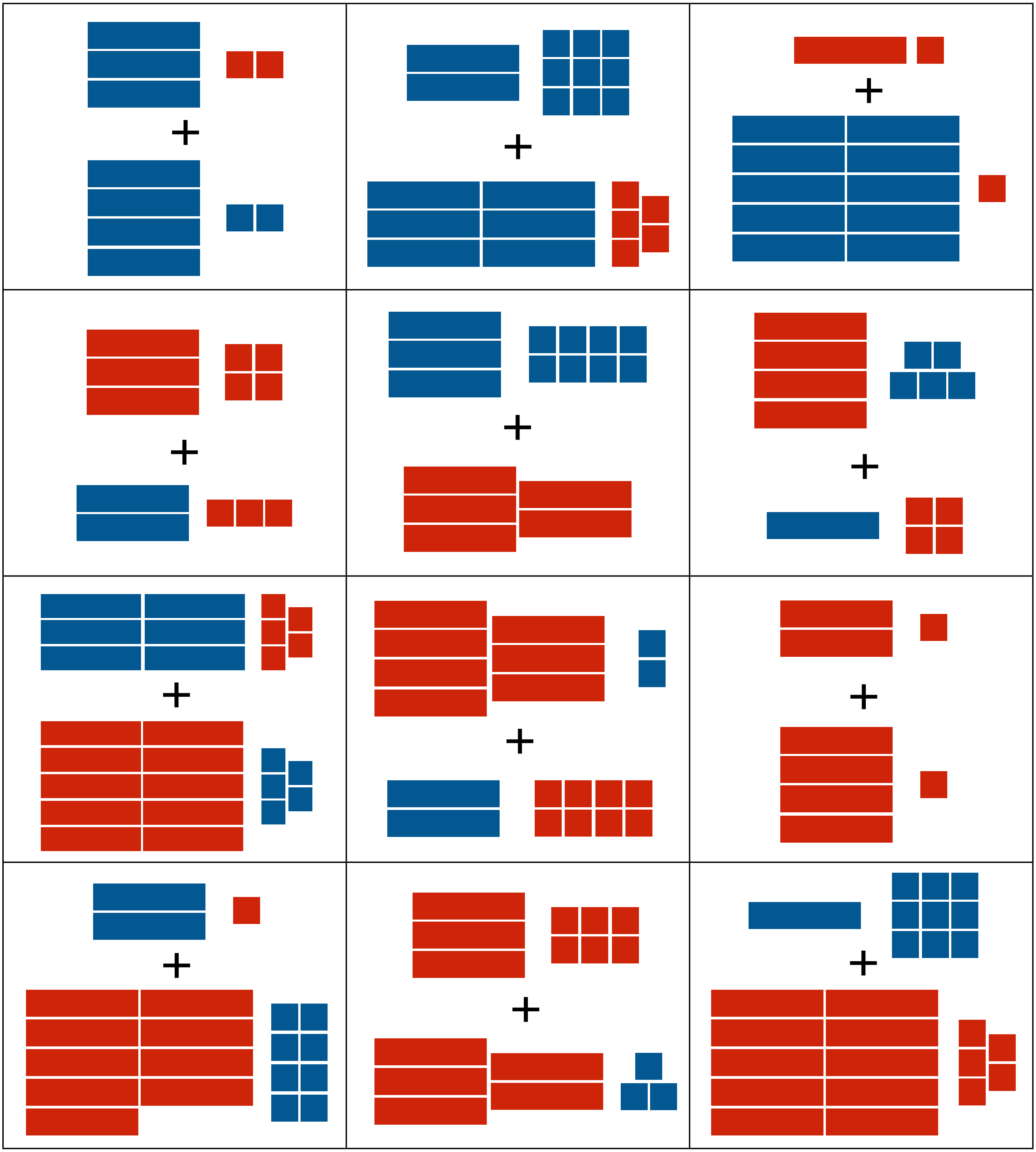
Students will write a sum in each box of the bingo card.

$x + 8$	$2x - 1$	$3x - 8$	$4x + 3$	$5x - 3$	$6x + 1$
$7x$	$8x + 4$	$9x - 2$	$-x - 7$	$-2x + 8$	$-3x + 1$
$-4x$	$-5x - 6$	$-6x - 2$	$-7x + 7$	$-8x - 3$	$-9x + 4$
$2x + 2$	$3x - 9$	$-4x + 2$	$-5x + 7$	$6x - 3$	$-7x - 2$

Show one algebra tile equation card at a time. Have students solve and cross off the corresponding sum on their cards.



Cards cont. on next page



Cards cont. on next page

Tier 2-3 - Algebra Tile Cards cont.