

**Objective**

Solve equations with variables on both sides.

**Common Core State Standards**

- **8.EE.7b** Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

**Expressions and Equations****Solving Equations with Variables on Both Sides**

Another form of multi-step equations involves variables on both sides of the equation. Students will need to be able to manipulate the variables as well as constants in an equation. By understanding how to isolate the variables on one side of the equation, students will be able to solve real-world problems in algebra that involve variables on both sides of the equation.

**Try It!** Perform the Try It! activity on the next page.

**Talk About It**

Discuss the Try It! activity.

- **Ask:** *What is known? What is unknown? What is the objective when solving an equation using Algebra Tiles™?*
- **Ask:** *How will you get all the variable terms to one side of the equation? Does it matter which side of the equation we decide to collect the terms with the variables? Explain.*
- **Ask:** *How do you make sure that the equation remains balanced?*

**Solve It**

Read the problem with students. Have students solve the equation by creating a model with Algebra Tiles. Then have students sketch the model and record their work.

**More Ideas**

For another way to teach about solving equations with variables on both sides—

- Have students use Algeblocks® and the Algeblocks Sentences Mat to model each equation. Have students isolate the variable by gathering all of the variable terms on one side of the equal sign and all terms that do not have the variable on the other side of the equal sign. Then, students should finish solving the equation.

**Formative Assessment**

Have students try the following problem.

*Four more than three times a number is equal to two less than five times the number. What is the number?*

- A. 0.25
- B. 0.75
- C. 3
- D. 4

## Try It! 20 minutes | Groups of 3

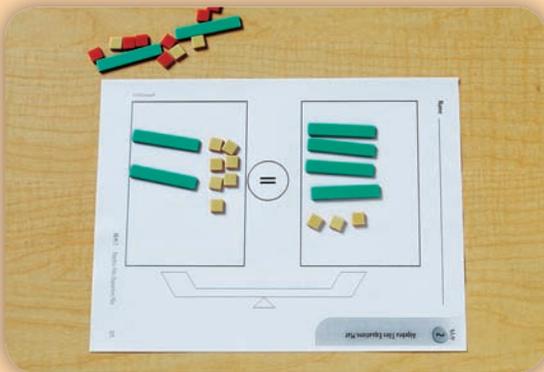
Here is a problem about solving equations with variables on both sides.

*Susan charges a \$7 fee plus \$2 per hour for tutoring. Joan charges a \$3 fee plus \$4 per hour. When will their tutoring fees be the same?*

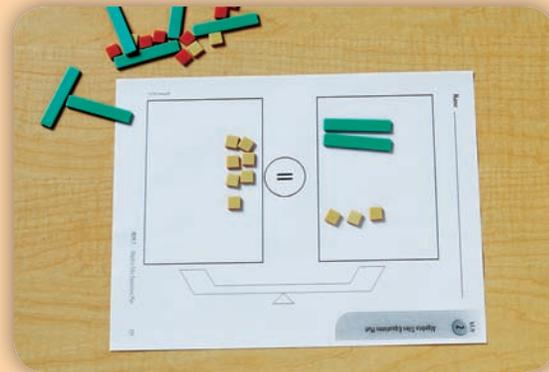
Introduce the problem. Then have students do the activity to solve the problem. Distribute the materials.

### Materials

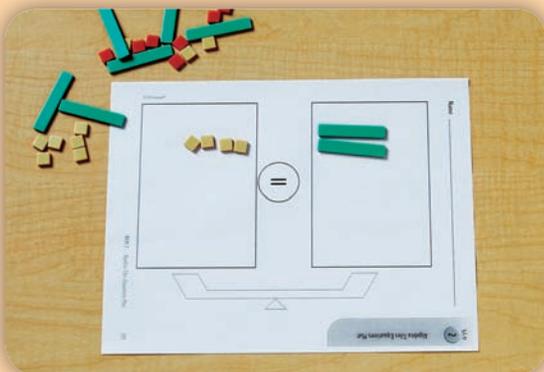
- Algebra Tiles™
- Algebra Tiles Equations Mat (BLM 2; 1 per group)
- Algebra Tiles Mini Equations Mats (BLM 3; 1 per student)



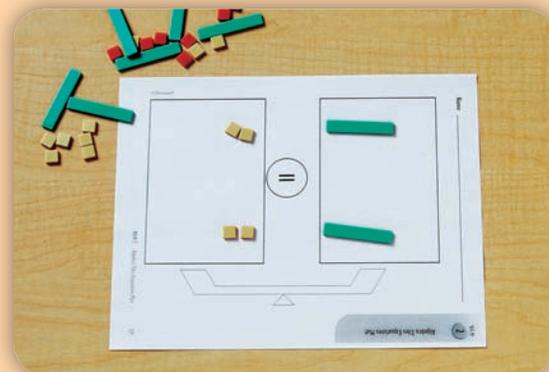
**1. Ask:** *What are we being asked to find?* Have students write what  $x$  represents. **Ask:** *What represents Susan's charge? Joan's charge?* Have students use tiles to model the charge for each. Have students draw the model on their Algebra Tiles Mini Equations Mats BLM 3 and write the equation. [ $2x + 7 = 4x + 3$ ]



**2. Ask:** *Which side do we want to collect the variable on?* Have students remove  $2x$  Algebra Tiles from each side. Then, they cross out the tiles on their mini mats and write the new equation [ $7 = 2x + 3$ ], showing the steps and results.



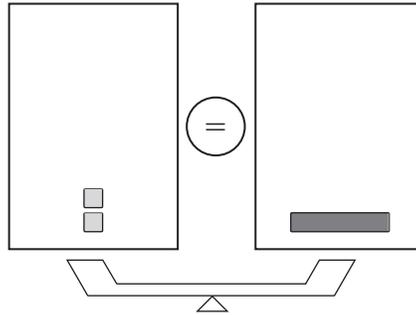
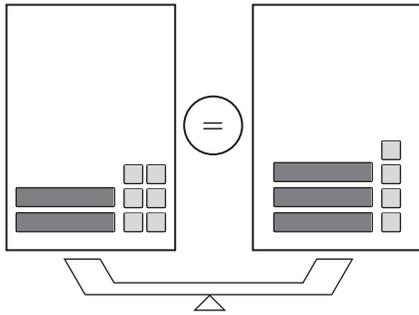
**3. Ask:** *How can we isolate the variable?* Have students remove 3 unit tiles from each side. Then, students should draw the tiles on their mini mats and write the steps they took and the resulting equation. [ $4 = 2x$ ]



**4. Say:** *We need to find the value of one  $x$ .* Have students create 2 equal groups on each side, and draw the groups on their mini mats. **Say:** *Circle your groups.* Students will show the division and the resulting equation. [ $4 \div 2 = x$ ]  
**Ask:** *When will their fees be the same?*

Use Algebra Tiles and the Algebra Tiles Equations Mat to model the equation shown and then solve it. Write the equation and the solution. (Check students' work.)

1.



$2x + 6 = 3x + 4$

$2 = x$

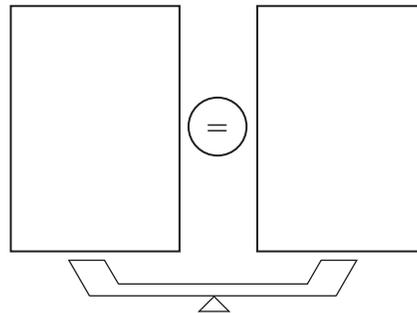
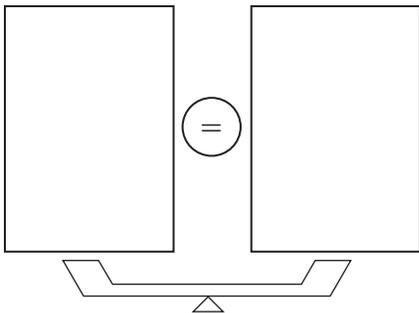
Using Algebra Tiles and the Algebra Tiles Equations Mat, model the equation. Sketch the model. Solve the equation and write the solution. (Check students' models.)

2.  $4x + 1 = x + 10$

$x = 3$

3.  $x + 5 = 3x + 1$

$2 = x$



Find each solution.

4.  $x + 10 = 2x$

$10 = x$

5.  $7x - 4 = 6x + 12$

$x = 16$

6.  $2x + 12 = 4x + 4$

$4 = x$

7.  $6x + 9 = 5x + 15$

$x = 6$

8.  $10x = 4x - 18$

$x = -3$

9.  $9x + 18 = 11x$

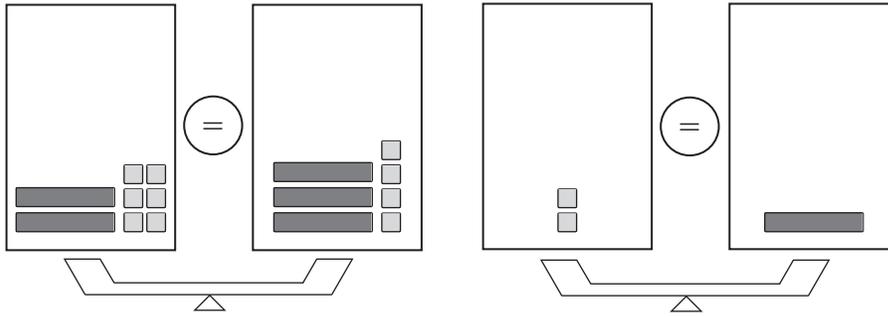
$9 = x$





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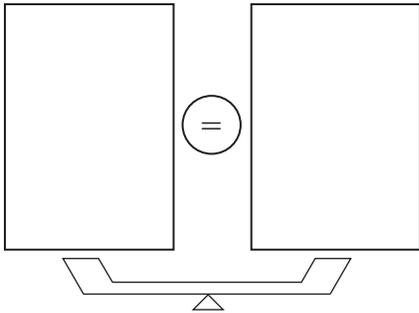

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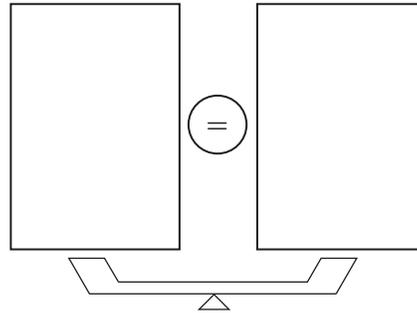
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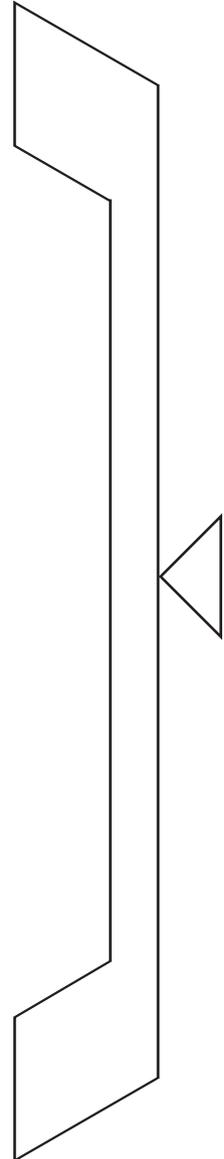
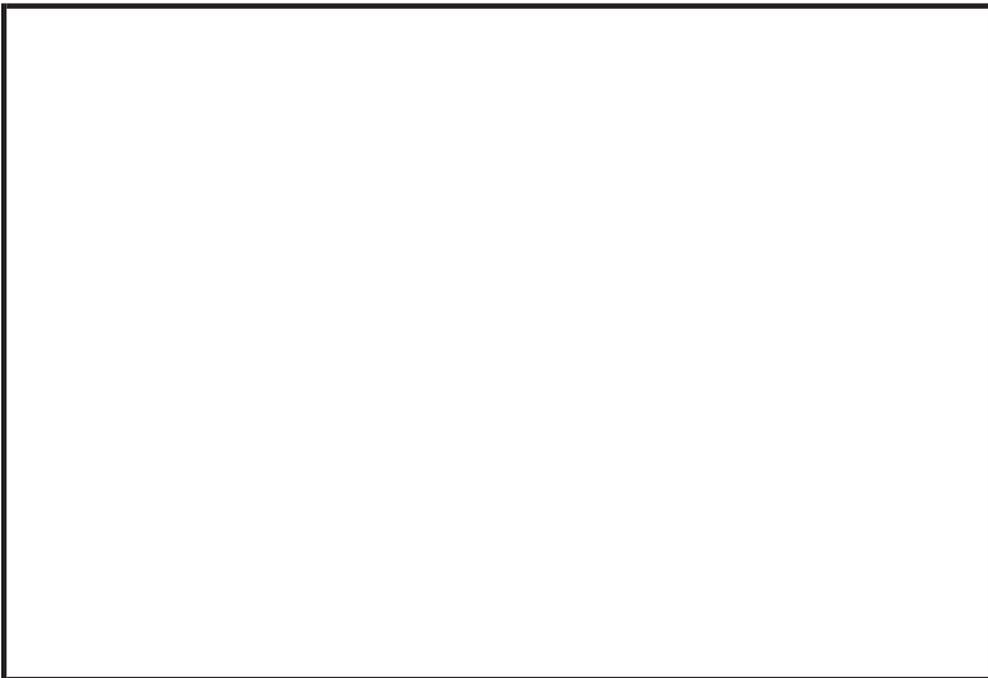
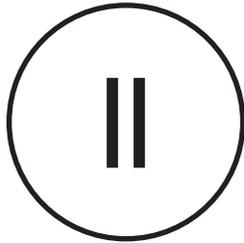
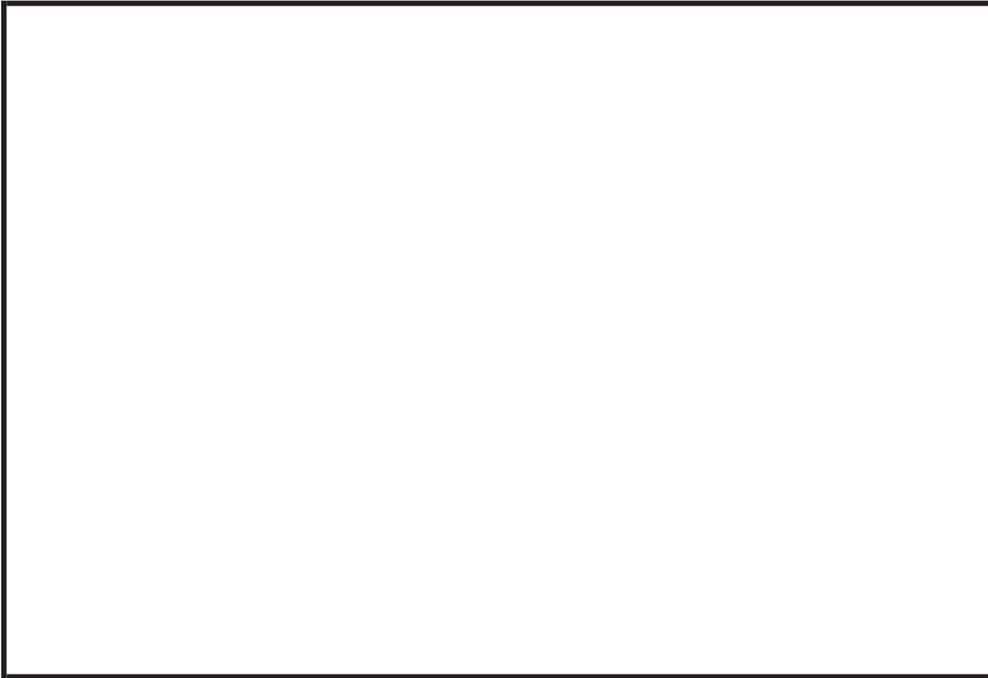
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Name \_\_\_\_\_



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