

Dear Family,

This week your student is exploring solutions of equations with variables.

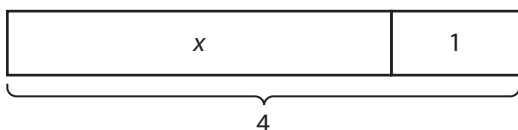
An equation uses an equal sign to show that two expressions have the same value. For example, $4 + 5$ and $6 + 3$ both equal 9. The equation $4 + 5 = 6 + 3$ shows that these two different numerical expressions have the same value.

Sometimes equations have variables that stand for unknown quantities. An equation is true when its two sides have the same value. A value of a variable that makes an equation true is a **solution of an equation**. For example, the equation $x + 3 = 5$ has a solution of **2** because $2 + 3 = 5$ is a true statement.

Your student will be learning to model solutions of equations like the one below.

Show that 3 is a solution of the equation $4 = x + 1$.

- ▶ **ONE WAY** to show that a number is a solution of an equation is to represent the equation with a bar model.



The bar model represents both the equation $4 = x + 1$ and the equation $x = 4 - 1$. The length of the bar labeled x is $4 - 1$, or 3.

- ▶ **ANOTHER WAY** is to use substitution.

$$4 = 1 + x$$

$$4 = 1 + 3 \quad \leftarrow \text{Substitute } 3 \text{ for } x.$$

$$4 = 4 \quad \leftarrow \text{The equation } 4 = 4 \text{ is a true statement.}$$

If $x = 3$, then the equation $4 = 1 + x$ is true.

Both representations show that 3 is a solution of the equation $4 = x + 1$.

▶ Use the next page to start a conversation about solutions of equations.

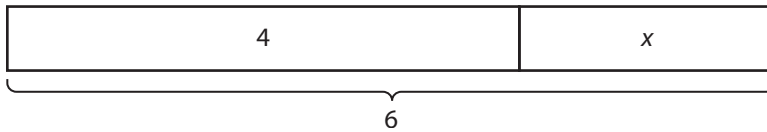
Activity Exploring Solutions of Equations

➤ Do this activity together to explore solutions of equations.

Set 1 and Set 2 each include a bar model that represents the relationship between the two sides of the given equation. The solution of the equation is also shown.

What do you notice in Set 1 and Set 2? Draw your own bar model in Set 3 and then write an equation to match.

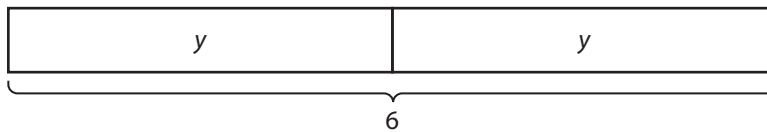
SET 1



Equation: $4 + x = 6$

Solution: $x = 2$

SET 2



Equation: $2y = 6$

Solution: $y = 3$

SET 3

Draw your own bar model that includes a variable. Then write an equation to match!



How can a bar model help you find the solution of an equation?

? **UNDERSTAND:** What does it mean to solve an equation?

Explore Solutions of Equations

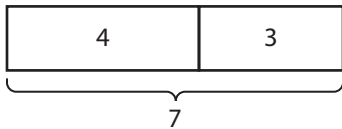


Model It

► Complete the problems about modeling equations.

- 1 The equal sign in an equation shows that the expression on the left side has the same value as the expression on the right side.

A bar model can represent the relationship between the two sides of an equation. Circle each equation that the bar model represents.



$4 + 3 = 7$

$4 = 12 \div 3$

$3 \cdot 4 = 12$

$4 = 7 - 3$

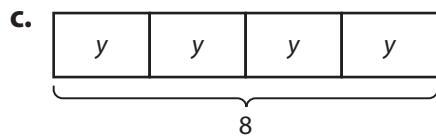
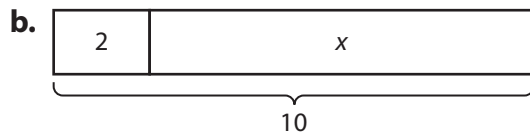
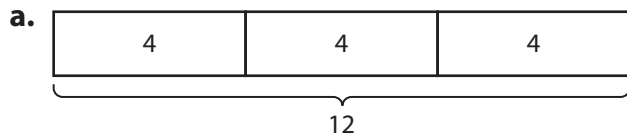
$7 + 4 = 11$

$7 = 3 + 4$

$7 - 4 = 3$

$7 \div 4 = 1\frac{3}{4}$

- 2 Write two different equations that each bar model represents.



DISCUSS IT

Ask: Why can you use more than one equation to represent the same bar model?

Share: A bar model helps me see ...

Learning Target SMP 2, SMP 3, SMP 7

Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.

Model It

► Complete the problems about equations with variables.

3 Complete the model to represent each equation.

a. $15 = 3 + x$



b. $15 = 3 \cdot x$



4 An equation is true when its two sides have the same value. A value of a variable that makes an equation true is a **solution of the equation**.

Use your models from problem 3 to find a solution of each equation.
Explain your reasoning.

a. $15 = 3 + x$

b. $15 = 3 \cdot x$

DISCUSS IT

Ask: How do your bar models in problem 3 represent each side of the equation?

Share: I think the equation $15 = 3 + x$ has only one solution because ...

5 **Reflect** Explain what the equation $3x = 6$ means without using the word *equal*. Explain why 2 is a solution of the equation.

Prepare for Understanding Solutions of Equations

- 1 Think about what you know about expressions. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

In My Own Words

My Illustrations

equivalent expressions

Examples

Non-Examples

- 2 Circle all the expressions that are equivalent to 24.

$3(6)$

$6(4)$

$2 + 12$

$10 + 14$

$\frac{48}{2}$

$48 \div 2$

$30 - 8$

$8 + 8 + 4$

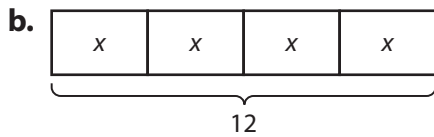
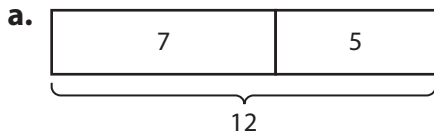
$4(2 + 10)$

$12(4 + 4)$



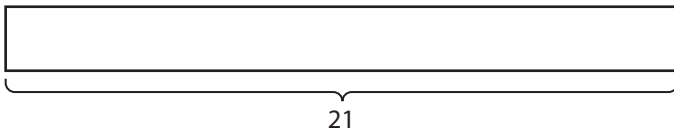
► Complete problems 3–5.

3 The egg carton has brown eggs and white eggs. The models represent two ways of showing the total number of eggs. Write two different equations that could represent each model.



4 Complete the model to represent each equation.

a. $21 = 7 + x$



b. $21 = 7 \cdot x$



5 Use your model from problem 4a to find a solution of the equation $21 = 7 + x$. Explain your reasoning.

Vocabulary

equation

a mathematical statement that uses an equal sign (=) to show that two expressions have the same value.

solution of an equation

a value of a variable that makes an equation a true statement.

Develop Understanding of Solutions of Equations

Model It: Hanger Diagrams

► Try these two problems about equations and hanger diagrams.

- 1 A hanger diagram uses shapes that represent weights to model two expressions. When the expressions have the same value, the hanger is level, or balanced. An unbalanced hanger shows that two expressions do not have the same value. Complete the statements by writing the total weight for each side of the hanger.

a.

$3 + 1 = 2 + 1 + 1$

_____ = _____

b.

$3 + 1 > 2 + 1$

_____ > _____

DISCUSS IT

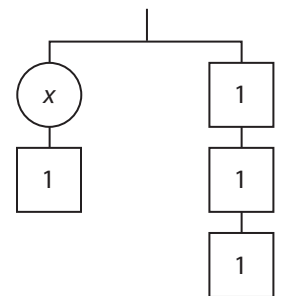
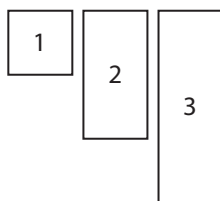
Ask: How is a hanger diagram different from a bar model? How is it similar?

Share: I think the right side of a hanger is lower than the left side when...

- 2 Use the balanced hanger at the right.

a. Explain why the hanger diagram represents the equation $x + 1 = 3$.

b. Tell whether the hanger would be *balanced* or *unbalanced* if you replaced the x -weight with each of the weights shown below. Explain your reasoning for each weight.



c. Which value in the set $\{1, 2, 3\}$ is a solution of the equation $x + 1 = 3$?

Model It: Substitution

► Try this problem involving substitution.

- 3 An equation with a variable may be true or false, depending on the value of the variable. You can use substitution to decide.

a. Complete the statements to show that 9 is not a solution of $2 + x = 9$.

$$2 + x = 9$$

$$2 + \underline{\quad} = 9 \quad \leftarrow \text{Substitute } 9 \text{ for } x.$$

$$\underline{\quad} = 9$$

The equation $\underline{\quad} = 9$ is false, so $\underline{\quad}$ is not a solution of $2 + x = 9$.

b. Complete the statements to show that 7 is a solution of $2 + x = 9$.

$$2 + x = 9$$

$$2 + \underline{\quad} = 9 \quad \leftarrow \text{Substitute } 7 \text{ for } x.$$

$$\underline{\quad} = 9$$

The equation $\underline{\quad} = 9$ is true, so $\underline{\quad}$ is a solution of $2 + x = 9$.

DISCUSS IT

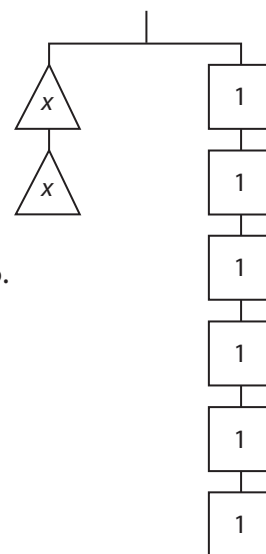
Ask: When does an equation make a false statement?

Share: I think a hanger diagram for the equation $2 + x = 9$ would show ...

CONNECT IT

► Complete the problems below.

- 4 Could x represent a value of 4 in the hanger diagram? Use an equation and substitution to support your answer.



- 5 Show whether each value in the set $\{2, 3, 4\}$ is a solution of the equation $x + 2 = 6$.

Practice Identifying Solutions of Equations

- Study how the Example shows using substitution to determine if values in a set include a solution of an equation. Then solve problems 1–6.

Example

Use substitution to decide whether each value in the set $\{7, 8, 9\}$ is a solution of the equation $28 = x \cdot 4$.

Substitute each value for x . Compare the values of the two sides of the equation.

Substitute **7** for x .

$$28 = x \cdot 4$$

$$28 = 7 \cdot 4$$

$$28 = 28 \leftarrow \text{true}$$

Substitute **8** for x .

$$28 = x \cdot 4$$

$$28 = 8 \cdot 4$$

$$28 = 32 \leftarrow \text{false}$$

Substitute **9** for x .

$$28 = x \cdot 4$$

$$28 = 9 \cdot 4$$

$$28 = 36 \leftarrow \text{false}$$

When x is 7, the equation is true. So, 7 is a solution of $28 = x \cdot 4$.

When x is 8 or 9, the equation is false. So, 8 and 9 are not solutions of $28 = x \cdot 4$.

- Suppose the equation $28 = x \cdot 4$ in the Example is written in the form $4x = 28$. Is 7 still a solution? Explain.
- Use substitution to determine if 0 is a solution of $5x = 5$.
- Lucía says that 35 and 65 are both solutions of the equation $50 = x + 15$. Is Lucía correct? Explain your answer.

Vocabulary

equation

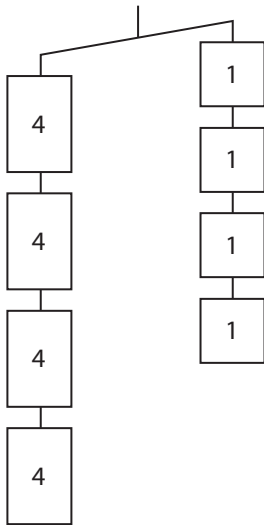
a mathematical statement that uses an equal sign ($=$) to show that two expressions have the same value.

solution of an equation

a value that can be substituted for a variable to make an equation true.

4 Complete the statements to show the total weight for each side of the hanger.

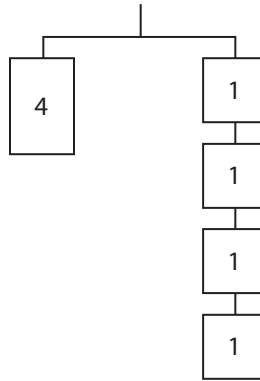
a.



$$4 \cdot \underline{\quad} > 4 \cdot \underline{\quad}$$

$$\underline{\quad} > \underline{\quad}$$

b.



$$\underline{\quad} = 1 + 1 + 1 + \underline{\quad}$$

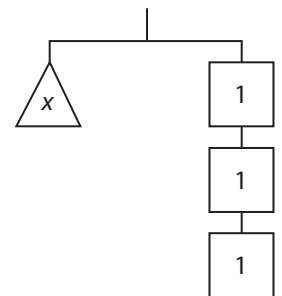
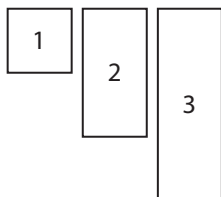
$$\underline{\quad} = \underline{\quad}$$

5 Demarco substitutes a value for x in the equation $\frac{1}{2}x = 4$.

a. How will Demarco know if the value is a solution of the equation?

b. Is 8 a solution of the equation? Explain.

6 Use the balanced hanger at the right. Tell whether the hanger will be *balanced* or *unbalanced* when you replace the x -weight with each weight shown below. Explain your reasoning for each weight.

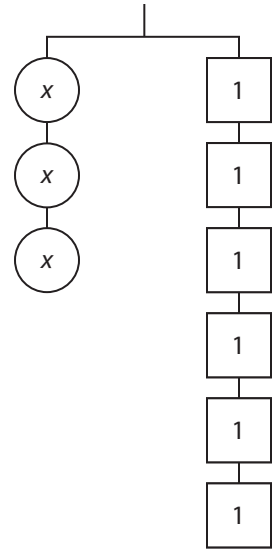


Refine Ideas About Solutions of Equations

Apply It

► Complete problems 1–5.

1 Identify Greg says that x could represent a value of 3 in the hanger diagram. Do you agree? Explain your reasoning.



2 Demonstrate Write an equation with a solution of 8. Use the variable x and at least three terms in your equation. Explain why 8 is a solution.

3 Validate Bianca substitutes a value for x in the equation $4x = 2x + 6$.

- a. How will Bianca know if the value is a solution of the equation?

- b. Is 3 a solution of the equation? Explain your reasoning.

- 4 Cai writes the equation $a \cdot b = c$.

PART A If a is 4, b is 5, and c is 9, is the equation true? Explain your reasoning.

PART B There are many combinations of values for a , b , and c that make the equation true. Together, these values form a solution of the equation. Find a combination of values for a , b , and c that is a solution of the equation. Explain your reasoning.

- 5 **Math Journal** Mr. Ramírez writes the equation $x + 1 = 7$ and the set $\{2, 3, 6, 7\}$ on the board. Tell if each value in the set is a solution of the equation and why. What does it mean to solve the equation $x + 1 = 7$?

End of Lesson Checklist

- INTERACTIVE GLOSSARY** Find the entry for *solution of an equation*. Add two important things you learned about equations in this lesson.