Lesson 18: Equivalent Expressions

Two expressions may look different even though they represent the same information or value. These expressions are said to be **equivalent.** You can use the commutative, associative, and distributive properties to find out whether two expressions are equivalent.

Example

Are the following two expressions equivalent?

$5(x + 3) \qquad 5x + 15$

Using the distributive property, rewrite one of the expressions.

$$\begin{aligned} 5(x + 3) &= 5 \bullet x + 5 \bullet 3 \\ &= 5x + 15 \end{aligned}$$

Because $5(x + 3) = 5x + 15$, the expressions are equivalent.

Two expressions are also equivalent if you substitute the same value for the same variables and both expressions are equal.

Example

Determine whether $(x + 3) + 4$ is equivalent to $x + 8$ by letting $x = 3$ and $x = -2$.

When $x = 3$:

$$\begin{aligned} (x + 3) + 4 &= ((3) + 3) + 4 \\ &= (6) + 4 \\ &= 10 \end{aligned} \qquad \begin{aligned} x + 8 &= (3) + 8 \\ &= 11 \end{aligned}$$

When $x = -2$:

$$\begin{aligned} (x + 3) + 4 &= ((-2) + 3) + 4 \\ &= (1) + 4 \\ &= 5 \end{aligned} \qquad \begin{aligned} x + 8 &= (-2) + 8 \\ &= 6 \end{aligned}$$

For both of these x-values, the two expressions don't agree. The expressions $(x + 3) + 4$ and $x + 8$ are not equivalent.

CCSS: 6.NS.4, 6.EE.3, 6.EE.4

You can often simplify an expression to create an equivalent expression. You may need to use the order of operations.

Example

Simplify the following expression to create an equivalent expression.

$3(x + 12) + 2x - 11$

To simplify the expression, you can use the distributive property. Then you can combine the like terms. Be sure to follow the order of operations.

$3(x + 12) + 2x - 11$	
$3 \bullet x + 3 \bullet 12 + 2x - 11$	**Use the distributive property.**
$3x + 36 + 2x - 11$	**Perform the multiplication first.**
$5x + 25$	**Combine the like terms.**

Because $3(x + 12) + 2x - 11 = 5x + 25$, the expressions are equivalent.

Example

Simplify the following expression to create an equivalent expression.

$4(\frac{3}{2}x + 2) \div 2 - 2^2 \bullet x$

To simplify the expression, you can use the distributive property. Then you can combine the like terms. Be sure to follow the order of operations.

$4(\frac{3}{2}x + 2) \div 2 - 2^2 \bullet x$	
$4(\frac{3}{2}x + 2) \div 2 - 4 \bullet x$	**Simplify the exponents first.**
$(4 \bullet \frac{3}{2}x + 4 \bullet 2) \div 2 - 4 \bullet x$	**Use the distributive property.**
$(6x + 4 \bullet 2) \div 2 - 4 \bullet x$	**Multiply/divide from left to right.**
$(6x + 8) \div 2 - 4 \bullet x$	**Multiply/divide from left to right.**
$3x + 4 - 4 \bullet x$	**Multiply/divide from left to right.**
$3x + 4 - 4x$	**Multiply/divide from left to right.**
$-x + 4$	**Combine like terms.**

$4(\frac{3}{2}x + 2) \div 2 - 2^2 \bullet x$ is equivalent to $-x + 4$.

TIP: The order of operations states that all operations within **P**arentheses are solved first, followed by **E**xponents. **M**ultiplication and **D**ivision are then solved from left to right, followed by **A**ddition and **S**ubtraction from left to right. These operations can be abbreviated as PEMDAS.