

# Lesson 8: Reasoning about Solving Equations (Part 2)

Let's use hangers to understand two different ways of solving equations with parentheses.

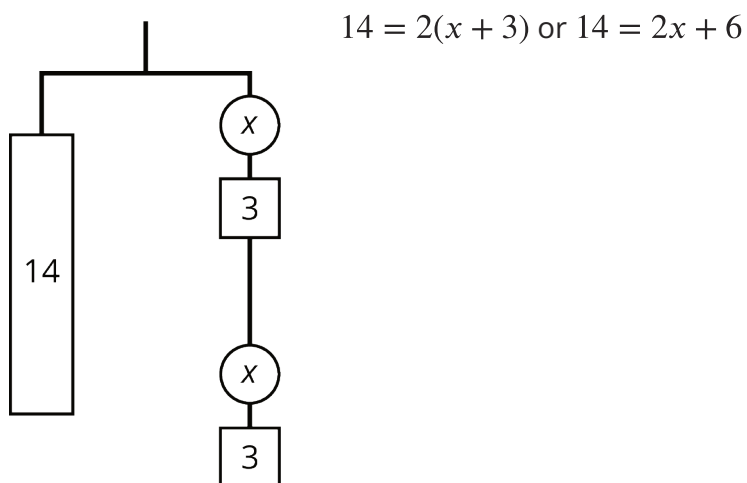
## 8.1: Equivalent to $2(x + 3)$

Select **all** the expressions equivalent to  $2(x + 3)$ .

1.  $2 \cdot (x + 3)$
2.  $(x + 3)^2$
3.  $2 \cdot x + 2 \cdot 3$
4.  $2 \cdot x + 3$
5.  $(2 \cdot x) + 3$
6.  $(2 + x)^3$

## 8.2: Either Or

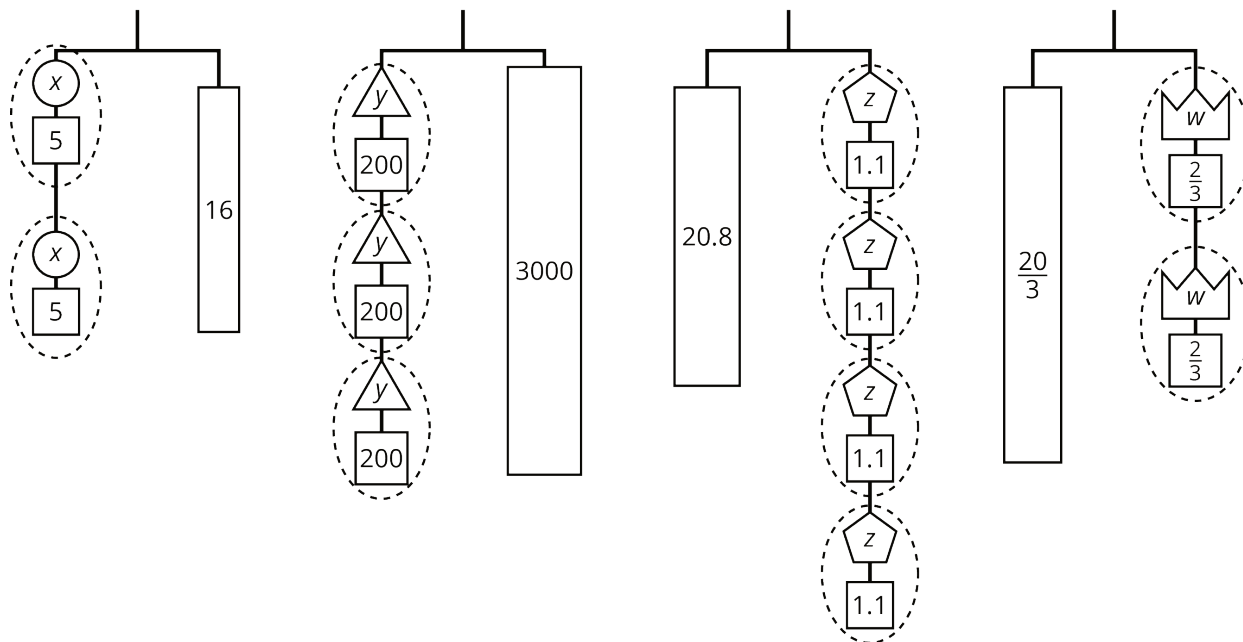
1. Explain why either of these equations could represent this hanger:



2. Find the weight of one circle. Be prepared to explain your reasoning.

### 8.3: Use Hangers to Understand Equation Solving, Again

Here are some balanced hangers. Each piece is labeled with its weight.



For each diagram:

1. Assign one of these equations to each hanger:

$$2(x + 5) = 16$$

$$3(y + 200) = 3,000$$

$$20.8 = 4(z + 1.1)$$

$$\frac{20}{3} = 2\left(w + \frac{2}{3}\right)$$

2. Explain how to figure out the weight of a piece labeled with a letter by reasoning about the diagram.
  
3. Explain how to figure out the weight of a piece labeled with a letter by reasoning about the equation.

## Lesson 8 Summary

The balanced hanger shows 3 equal, unknown weights and 3 2-unit weights on the left and an 18-unit weight on the right.

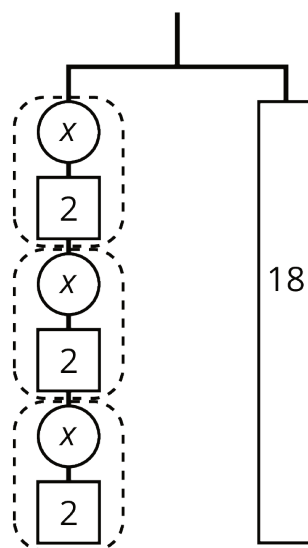
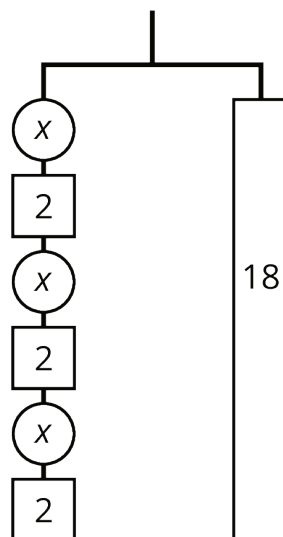
There are 3 unknown weights plus 6 units of weight on the left. We could represent this balanced hanger with an equation and solve the equation the same way we did before.

$$3x + 6 = 18$$

$$3x = 12$$

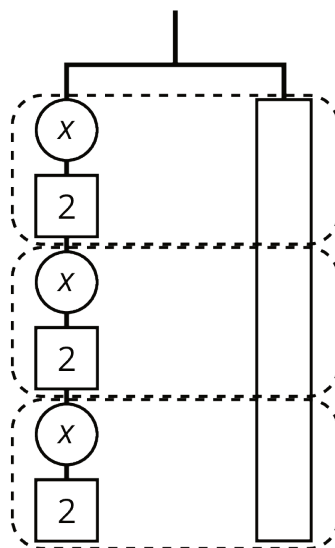
$$x = 4$$

Since there are 3 groups of  $x + 2$  on the left, we could represent this hanger with a different equation:  $3(x + 2) = 18$ .



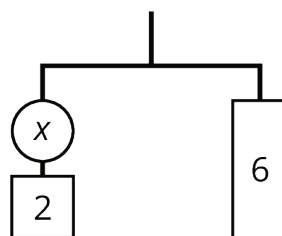
$$3(x + 2) = 18$$

The two sides of the hanger balance with these weights: 3 groups of  $x + 2$  on one side, and 18, or 3 groups of 6, on the other side.



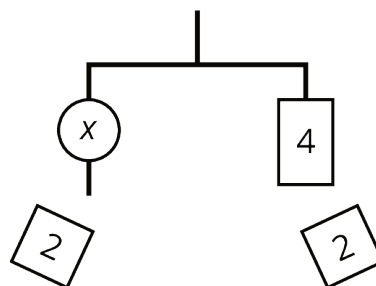
$$3(x + 2) = 18$$

The two sides of the hanger will balance with  $\frac{1}{3}$  of the weight on each side:  
 $\frac{1}{3} \cdot 3(x + 2) = \frac{1}{3} \cdot 18.$



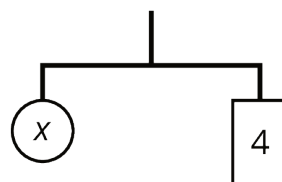
$$x + 2 = 6$$

We can remove 2 units of weight from each side, and the hanger will stay balanced. This is the same as subtracting 2 from each side of the equation.



$$x + 2 = 4 + 2$$

An equation for the new balanced hanger is  $x = 4$ . This gives the solution to the original equation.



$$x = 4$$

Here is a concise way to write the steps above:

$$3(x + 2) = 18$$

$$x + 2 = 6 \quad \text{after multiplying each side by } \frac{1}{3}$$

$$x = 4 \quad \text{after subtracting 2 from each side}$$