BART LETT

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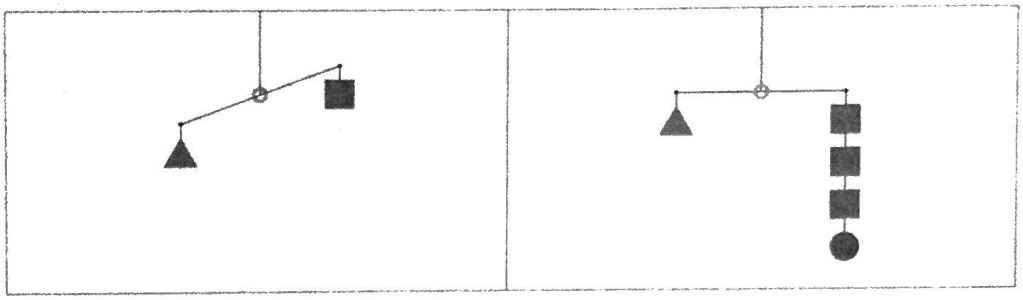
Unit 6, Lesson 7: Reasoning about Solving Equations (Part 1) 5 mins. 1 min. - socks

Let's see how a balanced hanger is like an equation and how moving its weights is like solving the equation. 2 mins.

7.1: Hanger Diagrams



In the two diagrams, all the triangles weigh the same and all the squares weigh the same.

For each diagram, come up with . . .

1. One thing that *must* be true
   Triangle heavier than square - $1\triangle = 3\square + 10$
2. One thing that *could* be true
   Triangle weighs 32 oz., square 10 oz., circle 2 oz.
3. One thing that *cannot possibly* be true
   Triangle & Square weigh the same

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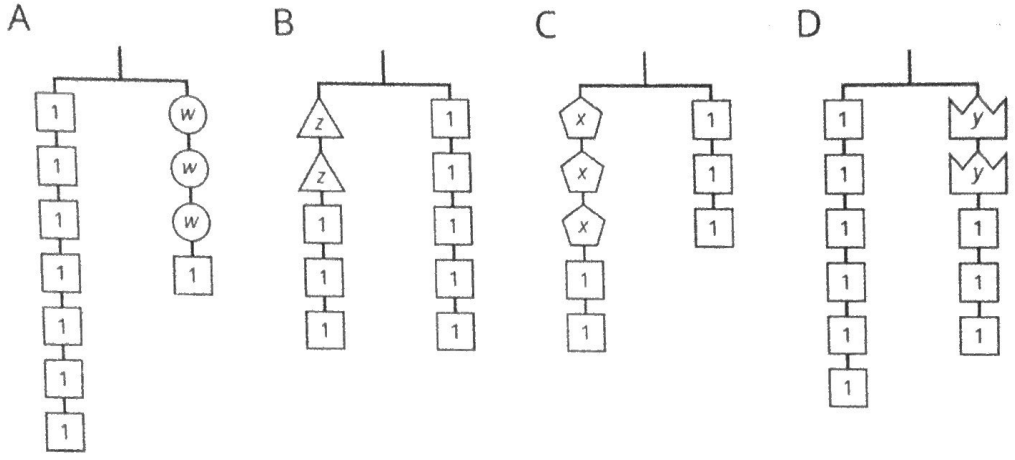
10 mins. 3 mins. quiet work, partner, whole class

7.2: Hanger and Equation Matching

On each balanced hanger, figures with the same letter have the same weight.



B • $2\boxed{z} + 3 = 5$ $z = 1$ $1\triangle = 1\square$

C • $3\boxed{x} + 2 = 3$ $x = 1/3$ $3\pentagon = 1\square$

D • $6 = 2\boxed{y} + 3$ $y = 3/2$ or 1.5 $2\crown = 3\square$

A • $7 = 3\boxed{w} + 1$ $w = 2$ $1\bigcirc = 2\square$

1. Match each hanger to an equation. Complete the equation by writing x, y, z, or w in the empty box.

2. Find the solution to each equation. Use the hanger to explain what the solution means.

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Unit 6, Lesson 8: Reasoning about Solving Equations (Part 2)

5 mins. 2 mins. work, partner, discuss

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 $2(x + 3)$.

write another if finished early:

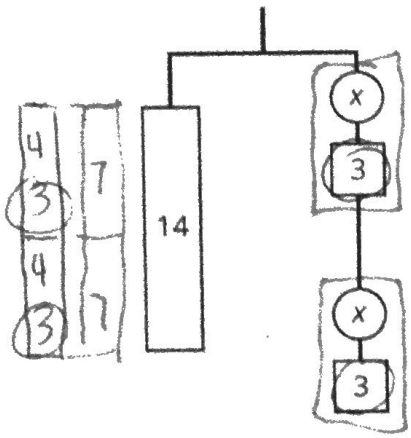
1. $2 \cdot (x + 3)$
2. $(x + 3)2$
3. $2 \cdot x + 2 \cdot 3$
4. $2 \cdot x + 3$
5. $(2 \cdot x) + 3$
6. $(2 + x)3$

$2x + 6$

8.2: Either Or

10 mins.

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



$14 = 2(x + 3)$ or $14 = 2x + 6$

14 is balanced with 2 groups of $x + 3$ $14 = 2(x + 3)$

14 is balanced with 2 x's and 6 units of weight

$14 = 2x + 6$

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

$x = 4$ units

$x + 3 = 7$

$x = 4$

$p(x+q)=r$ $px+pq=r$

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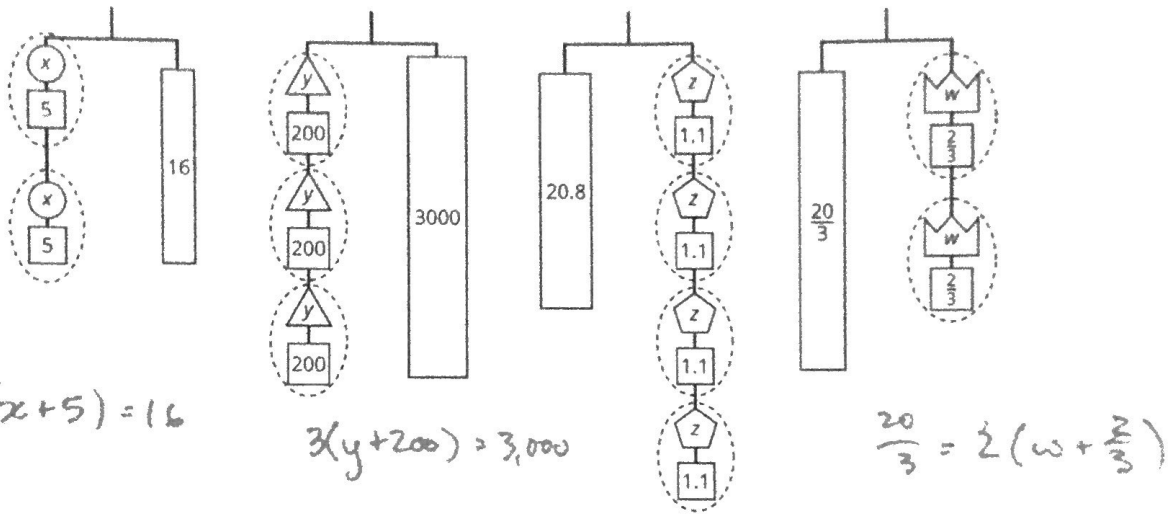
10 mins. 3 mins. work, partner, discuss

8.3: Use Hangers to Understand Equation Solving, Again

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



$2(x+5)=16$

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

$20.8=4(z+1.1)$

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

For each diagram:

1. Assign one of these equations to each hanger:

$2(x+5)=16$

$x=3$

$20.8=4(z+1.1)$

$z=4.1$

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

$y=800$

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

$w=\frac{8}{3}$

$\frac{20}{3}=2w+\frac{4}{3}$ or $2\frac{2}{3}$

$\frac{16}{3}\div\frac{2}{1}=\frac{16}{6}=\frac{8}{3}$

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.

Partners Choose

e.g. $4(x+7)=40$ 1) Divide by 4 first

2) Distribute 4 first

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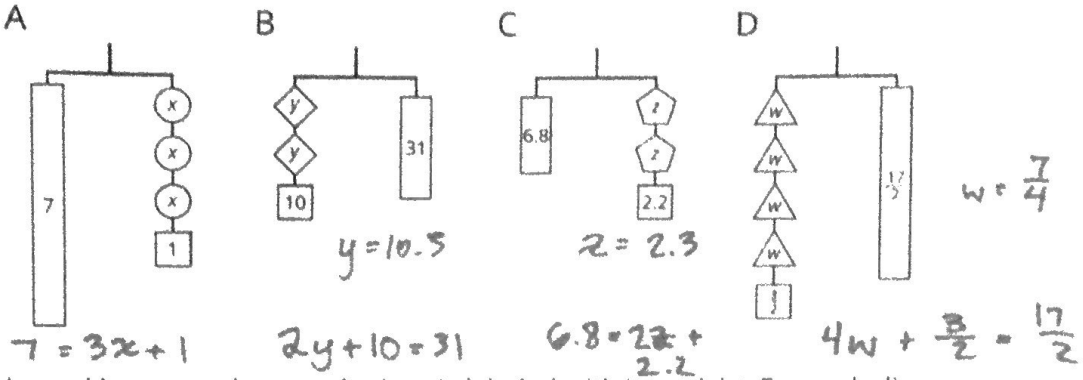
Extra Practice 5 min. work, partner, class

7.3: Use Hangers to Understand Equation Solving



$x = 2$ $y = 10.5$ $z = 2.3$ $w = \frac{7}{4}$

$7 = 3x + 1$ $2y + 10 = 31$ $6.8 = 2z + 2.2$ $4w + \frac{3}{2} = \frac{17}{2}$

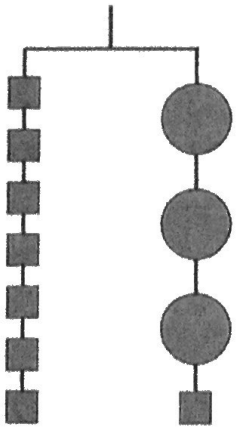
Here are some balanced hangers where each piece is labeled with its weight. For each diagram:

1. Write an equation.
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 7 Summary

In this lesson, we worked with two ways to show that two amounts are equal: a balanced hanger and an equation. We can use a balanced hanger to think about steps to finding an unknown amount in an associated equation.

The hanger shows a total weight of 7 units on one side that is balanced with 3 equal, unknown weights and a 1-unit weight on the other. An equation that represents the relationship is $7 = 3x + 1$.



$7 = 3x + 1$

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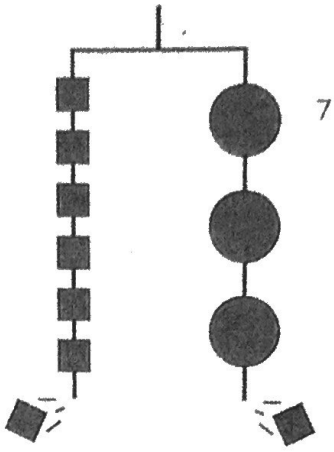
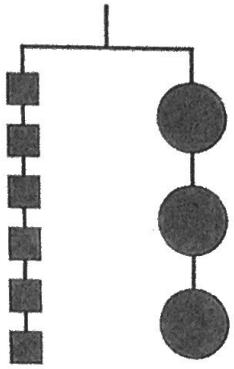
We can remove a weight of 1 unit from each side and the hanger will stay balanced. This is the same as subtracting 1 from each side of the equation.



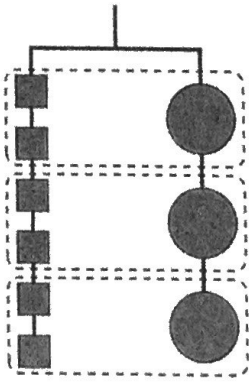
$7 - 1 = 3x + 1 - 1$

An equation for the new balanced hanger is $6 = 3x$.



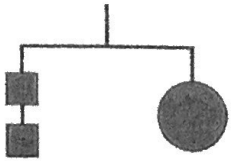
$6 = 3x$

So the hanger will balance with $\frac{1}{3}$ of the weight on each side: $\frac{1}{3} \cdot 6 = \frac{1}{3} \cdot 3x$.



$6 = 3x$

The two sides of the hanger balance with these weights: 6 1-unit weights on one side and 3 weights of unknown size on the other side.



$2 = x$

Here is a concise way to write the steps above:

$7 = 3x + 1$

$6 = 3x$ after subtracting 1 from each side

$2 = x$ after multiplying each side by $\frac{1}{3}$

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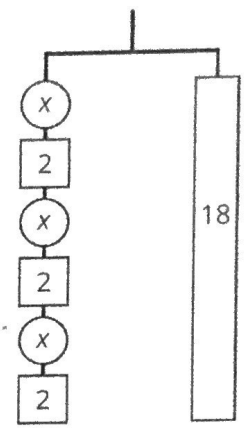
Lesson 8 Summary

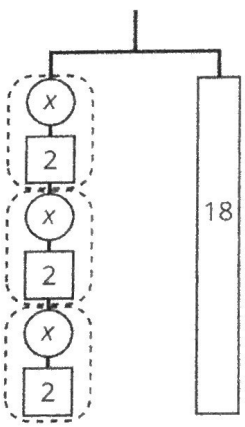
The balanced hanger shows 3 equal, unknown weights and 3 2-unit weights on the left and an 18-unit weight on the right.



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



$3(x + 2) = 18$

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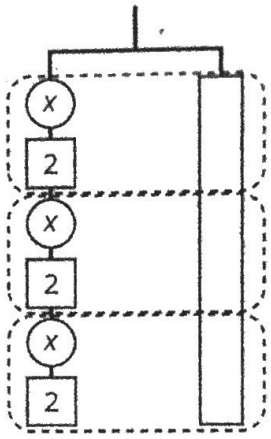
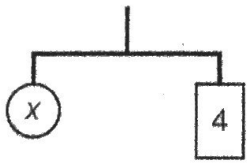
The two sides of the hanger balance with these weights: 3 groups of $x + 2$ on one side, and 18, or 3 groups of 6, on the other side.



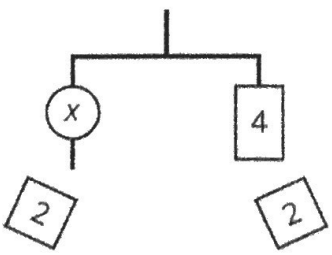
$3(x + 2) = 18$

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



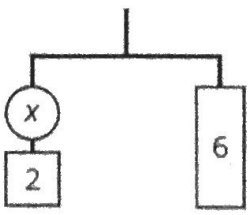
$x = 4$

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.



$x + 2 = 6$

Here is a concise way to write the steps above:

$$3(x + 2) = 18$$
$$x + 2 = 6 \quad \text{after multiplying each side by } \tfrac{1}{3}$$
$$x = 4 \quad \text{after subtracting 2 from each side}$$