# Equivalent Equations

You will need
- balance scales
- linking cubes
- small paper bags

GOAL

Model and create equivalent equations.

Samara put the same number of linking cubes in each of two paper bags. She wrote *n* on both bags to show that the number of cubes was the same.

Samara wrote the **equation** $2n = 8$ to show that she needed eight cubes to balance the two bags on balance scales. The number of cubes that *n* represents is called the **solution to the equation**.
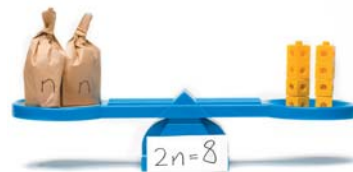
> **solution to the equation**
>
> The number that makes the equation a true statement
>
> For example, the solution to $x - 2 = 4$ is $x = 6$ because $6 - 2 = 4$.

How can you model and create new equations with the same solution as $2n = 8$?
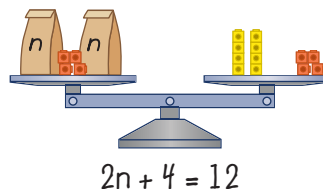
Oleh's Balance Scales

I put four more cubes on each pan.

The pans are still balanced because I added the same mass to each pan.

Now the model shows $2n + 4 = 12$.

I didn't change the number of cubes in each bag, so *n* is the same number. My model shows that the equations $2n = 8$ and $2n + 4 = 12$ are **equivalent equations**.
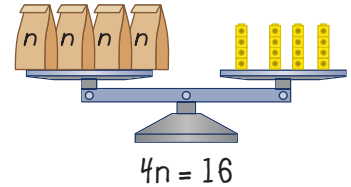
> **equivalent equations**
>
> Equations that have exactly the same solution

Léa's Balance Scales

I multiplied the amounts on both sides by 2.

The pans are still balanced because, when I doubled the amount, I added the same mass to both sides.

Now the balance scales show $4n = 16$.

I didn't change the number of cubes in the bags, so n is still the same number. My model shows that $2n = 8$ and $4n = 16$ are equivalent equations.

$4n = 16$

A. How many cubes are in each bag? Explain how you know.

B. How can you show that Oleh's equation and Léa's equation have the same solution as Samara's equation?

C. Will you get an equivalent equation if you subtract 1 from both sides of $2n + 4 = 12$? Sketch balance scales to explain.

D. Will you get an equivalent equation if you divide both sides of $2n = 8$ by 2? Sketch balance scales to explain.

E. Write two more equations that are equivalent to $2n = 8$. Show how you figured out each equation.

Reflecting

F. What kinds of changes can you make to an equation to get an equivalent equation? Use the equation $n + 1 = 3$ to explain.

G. What kinds of changes to an equation would not result in an equivalent equation?
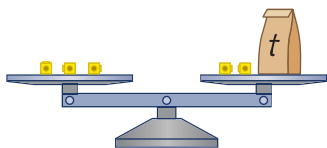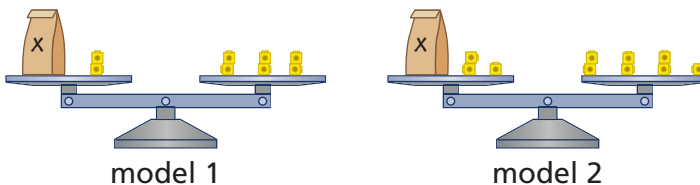
Checking

1. Tao made a model on balance scales.
   a) What equation is Tao modelling?
   b) How many cubes are in Tao's bag? Explain how you know.
   c) Is the equation $9 = 6 + 3t$ equivalent to Tao's equation? Explain how you know.

Practising

2. Is $2m + 1 = 9$ equivalent to $2m + 2 = 8$? Explain your thinking.

3. a) Write an equation that represents each model.

model 1   model 2

   b) Are your equations from part a) equivalent? Explain how you know.

4. a) Which equations are equivalent to $4n = 8$? Explain how you know.

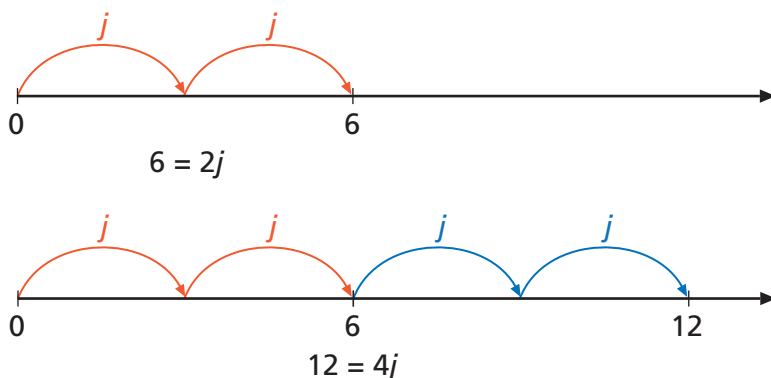|	
$4n + 2 = 10$	$16n = 32$
$2n = 4$	$8n = 10$
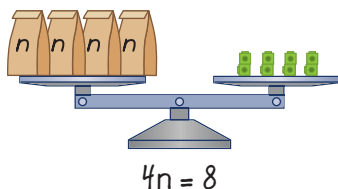
   b) Write one more equation that is equivalent to $4n = 8$. Explain how you know that your equation is equivalent to $4n = 8$.

> There are lots of ways to get an equivalent equation by doing the same operation on both sides.

$4n = 8$

5. Grace says that these number lines show that $6 = 2j$ is equivalent to $12 = 4j$. Is she correct? Explain.

$$6 = 2j$$

$$12 = 4j$$

6. Two students made different models with bags and cubes.

Situation 1: Sage started with 104 cubes. She put the same number of cubes in each of 2 bags and had 4 cubes left over.

Situation 2: Calvin started with 52 cubes. He put some of the cubes in one bag and had 2 cubes left over.

a) Sketch bags and cubes to show each situation.
b) Write an equation to show each situation.
c) Are the two equations in part b) equivalent? Explain.
d) How many cubes are in the bags? Explain how you know.

7. How can you tell that the two equations in each pair of equations are not equivalent?
a) $4n = 8$ and $4n + 1 = 8$
b) $n + 3 = 9$ and $2n + 6 = 12$
c) $2n = 6$ and $2n - 1 = 7$

8. What are some different ways to figure out if two equations are equivalent? Use an example to explain.