

**Display Master: Key Ideas: Determine Proportionality
by Using Cross Products**

- Patterns found when using common denominators to prove proportionality lead to the idea of cross products.
- Cross products can be used to prove proportionality. If the 2 numerators are equal, the ratios are proportional. If the 2 numerators are not equal, the ratios are not proportional.

Display Master: Salads A

The cafeteria serves 2 sizes of salads, large and small. The large salad has 3 pieces of cucumber for every 9 pieces of broccoli. The small salad has 2 pieces of cucumber for every 6 pieces of broccoli. Are the 2 ratios of cucumbers to broccoli proportional for the 2 salads?

$$\frac{3 \text{ pieces of cucumber}}{9 \text{ pieces of broccoli}} \quad \text{and} \quad \frac{2 \text{ pieces of cucumber}}{6 \text{ pieces of broccoli}}$$

$$9 \times 6 = 54$$

Therefore, our common denominator is 54.

Display Master: Salads B

$$\frac{3 \text{ pieces of cucumber}}{9 \text{ pieces of broccoli}} = \frac{x \text{ pieces of cucumber}}{54 \text{ pieces of broccoli}}$$


Display Master: Salads C

$$\frac{3 \text{ pieces of cucumber}}{9 \text{ pieces of broccoli}} = \frac{x \text{ pieces of cucumber}}{54 \text{ pieces of broccoli}}$$

Times what?

Display Master: Salads D

$$\frac{3 \text{ pieces of cucumber}}{9 \text{ pieces of broccoli}} = \frac{x \text{ pieces of cucumber}}{54 \text{ pieces of broccoli}}$$



 x 6

Display Master: Salads E

$$\frac{3 \text{ pieces of cucumber}}{9 \text{ pieces of broccoli}} = \frac{x \text{ pieces of cucumber}}{54 \text{ pieces of broccoli}}$$

$\times 6$ $\times 6$

Display Master: Salads F

$$\frac{3 \text{ pieces of cucumber}}{9 \text{ pieces of broccoli}} = \frac{\boxed{18} \text{ pieces of cucumber}}{54 \text{ pieces of broccoli}}$$

Therefore, $x = 18$ pieces of cucumber

Display Master: Salads G

$$\frac{2 \text{ pieces of cucumber}}{6 \text{ pieces of broccoli}} = \frac{x \text{ pieces of cucumber}}{54 \text{ pieces of broccoli}}$$


Display Master: Salads H

$$\frac{2 \text{ pieces of cucumber}}{6 \text{ pieces of broccoli}} = \frac{x \text{ pieces of cucumber}}{54 \text{ pieces of broccoli}}$$

Times what?

Display Master: Salads I

$$\frac{2 \text{ pieces of cucumber}}{6 \text{ pieces of broccoli}} = \frac{x \text{ pieces of cucumber}}{54 \text{ pieces of broccoli}}$$



x 9

Display Master: Salads J

$$\frac{2 \text{ pieces of cucumber}}{6 \text{ pieces of broccoli}} = \frac{x \text{ pieces of cucumber}}{54 \text{ pieces of broccoli}}$$

$\times 9$ $\times 9$

Display Master: Salads K

$$\frac{2 \text{ pieces of cucumber}}{6 \text{ pieces of broccoli}} = \frac{\boxed{18} \text{ pieces of cucumber}}{54 \text{ pieces of broccoli}}$$

Therefore, $x = 18$ pieces of cucumber

Display Master: Salads L

Since

$$\frac{3 \times 6}{9 \times 6} = \frac{18}{54}$$

And

$$\frac{2 \times 9}{6 \times 9} = \frac{18}{54}$$

Then

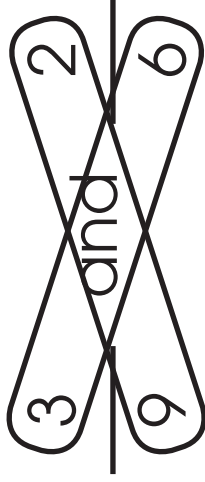
$$\frac{3}{9} = \frac{2}{6}$$

Therefore, the ratios are proportional.

Display Master: Salads M

Pieces of cucumber	
<hr/>	
Pieces of broccoli	

$$6 \times 3 = 18 \qquad 9 \times 2 = 18$$



$$18 = 18$$

Therefore, the ratios are
proportional.

Display Master: Jellybeans A

Rob's bag has 3 pink jellybeans for every 4 orange jellybeans. Mark's bag has 4 pink jellybeans for every 6 orange jellybeans. Are the ratios of pink to orange jellybeans in each bag proportional?

$$\frac{\text{Pink}}{\text{Orange}} = \frac{3}{4} \quad \text{and} \quad \frac{4}{6}$$

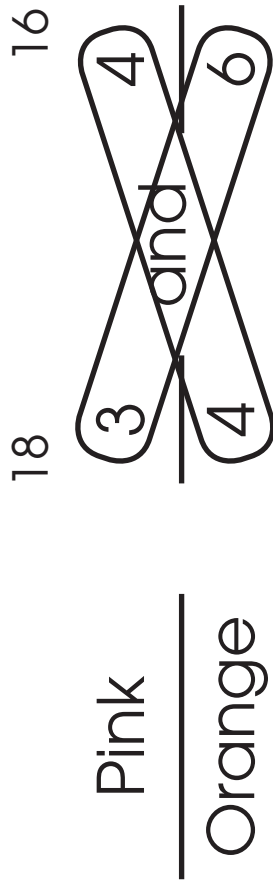
Display Master: Jellybeans B

Pink
—
Orange

$$\frac{3}{4} \text{ and } \frac{4}{6}$$

$$4 \times 4 = 16$$

Display Master: Jellybeans C



$$4 \times 4 = 16$$

$$6 \times 3 = 18$$

Display Master: Jellybeans D

$$\frac{\text{Pink}}{\text{Orange}} = \frac{3}{4} \text{ and } \frac{4}{6} \quad 4 \times 6 = 24$$

$$\frac{3 \cdot 6}{4 \cdot 6} = \frac{18}{24} \quad \frac{4 \cdot 4}{6 \cdot 4} = \frac{16}{24}$$

$$\frac{18}{24} \neq \frac{16}{24}$$

Display Master: Jellybeans E

$$\frac{\text{Pink}}{\text{Orange}} = \frac{18}{16}$$

$$\frac{3}{4} \text{ and } \frac{4}{6}$$

$$18 \neq 16$$

Therefore, the ratios are
not proportional.

Display Master: Cross Products A

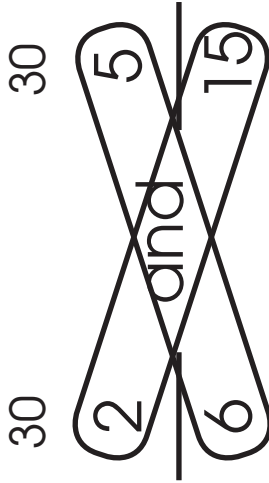
$$\frac{2}{6} \quad \text{and} \quad \frac{5}{15}$$

Display Master: Cross Products B

$$\begin{array}{r} 30 \\ 2 \end{array} \text{ and } \begin{array}{r} 5 \\ 6 \end{array} \quad \begin{array}{r} 15 \\ 6 \end{array}$$

$$6 \times 5 = 30$$

Display Master: Cross Products C



$$6 \times 5 = 30$$

$$15 \times 2 = 30$$

Display Master: Cross Products D

$$\begin{array}{ccc} 30 & & 30 \\ \swarrow & \text{and} & \searrow \\ 2 & & 5 \\ \nwarrow & & \nearrow \\ 6 & & 15 \end{array}$$

$$30 = 30$$

Therefore, the ratios are
proportional.