

### Solve & Discuss It!

Xander and Pedro are at an ice cream social. For every scoop of ice cream, Xander uses  $\frac{1}{4}$  cup of fruit topping. Pedro uses one more tablespoon of fruit topping than the number of scoops. If Xander and Pedro each use the same amount of fruit topping, how many scoops of ice cream does each use?

**Look for Relationships**  
There are 2 tablespoons in  $\frac{1}{4}$  cup.

### Lesson 3-6

Apply Proportional Reasoning to Solve Problems

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**I can...**  
determine whether a relationship is proportional and use representations to solve problems.



**Focus on math practices**

**Reasoning** For which person, Xander or Pedro, is the relationship between the quantities of ice cream and fruit topping proportional? Explain.

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**Essential Question** How can proportional reasoning help solve a problem?

INTERACTIVE ANIMATIONS


**EXAMPLE 1** Use Proportional Reasoning to Solve a Problem

The ratio of collectible cards DeShawn owns to cards that Stephanie owns is 5:2. Stephanie has 36 cards. How will the ratio of DeShawn's cards to Stephanie's cards change if they both sell half their cards? Explain.

DeShawn's Cards




Stephanie's Cards



**STEP 1** Draw a diagram that represents the ratio of DeShawn's cards to Stephanie's cards. You can use the diagram to find the number of cards DeShawn owns.

DeShawn's Cards

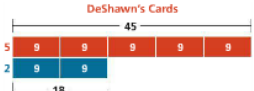


Stephanie's Cards

DeShawn owns 90 cards.

**STEP 2** Find the ratio after they sell half their cards.

DeShawn's Cards



Stephanie's Cards

DeShawn's Cards	5	90	45
Stephanie's Cards	2	36	18

Arrows indicate: 90 to 45 is  $\times \frac{1}{2}$ , 36 to 18 is  $\times \frac{1}{2}$ , and 5 to 2 is  $\times \frac{1}{2}$ .

After they both sell half their cards, the ratio is  $\frac{45}{18}$  or  $\frac{5}{2}$ . If the numbers of cards change by the same multiple, the ratio that relates them is equivalent, so it does not change.

**Try It!**

After selling half their card collections, DeShawn and Stephanie each buy 9 new cards. What is the ratio of the number of cards DeShawn has to the number Stephanie has?  $2:1$

**Convince Me!** Why did the ratio stay the same in the Example but change in the Try It?  
Sample answer: In the Example, multiplying both quantities by the same number gives a ratio that is equivalent to the original ratio. In the Try It, adding the same number to both quantities changes the relationship so it is not proportional.

200 3-6 Apply Proportional Reasoning to Solve Problems

**EXAMPLE 2** Recognize When to Use Proportional Reasoning

Martin is 6 years old when his sister Cassandra is 3 years old. How old will Martin be when Cassandra is 6 years old?

Make a table to find Martin's age.

**Use Structure** Look for a constant multiple to determine whether you can use proportional reasoning to solve this problem.

Martin's Age	Cassandra's Age
6	3
7	4
8	5
9	6

There is no constant multiple so you cannot use proportional reasoning. In 3 years when Cassandra is 6 years old, Martin will also be 3 years older, or 9 years old.

**EXAMPLE 3** Apply Proportional Reasoning

A video streaming service charged Bryan \$143.84 for a full year of access. Bryan thinks he was not charged the correct amount. What should Bryan say when he calls customer service?



**STEP 1** Write an equation to represent the situation.

The rate is \$8.99 per month. So an equation that represents the cost  $y$  after  $x$  months is  $y = 8.99x$ .

**STEP 2** Substitute the given information into the equation and solve.

**Option 1**

$$y = 8.99x$$

$$= 8.99(12)$$

$$= 107.88$$

Bryan should have been charged \$107.88. He should ask customer service for a credit of  $\$143.84 - \$107.88 = \$35.96$ .

**Option 2**

$$y = 8.99x$$

$$143.84 = 8.99x$$

$$\frac{143.84}{8.99} = \frac{8.99x}{8.99}$$

$$16 = x$$

Bryan was charged for 16 months, so he should ask customer service to give him 4 months of free online service.

**Try It!**

A florist makes bouquets that include 50 white flowers and 7 red flowers. If the florist orders 1,050 white flowers and 140 red flowers, there will be leftover flowers. How can the florist adjust the order so there are no leftover flowers?

**KEY CONCEPT**

Think about how two quantities are related before you decide to use proportional reasoning to solve a problem.

When Evie is 2 years old, Josh is 6 years old.  
Josh is 4 years older than Evie.  
Josh is 3 times as old as Evie.

In 2 years

When Evie is 4 years old, Josh is 8 years old.  
Josh is still 4 years older than Evie.  
Josh is now 2 times as old as Evie.

You cannot use proportional reasoning to solve this problem because Josh's age is not a constant multiple of Evie's age.

**\*proportional**

$\times$  or  $\div$  by same factor  
**NOT** + or -

**Do You Understand?**

- Essential Question** How can proportional reasoning help solve a problem?
- Use Appropriate Tools** How can knowing how to represent proportional relationships in different ways be useful in solving problems?
- Reasoning** How many ways are there to adjust two quantities so that they are in a given proportional relationship? Explain your reasoning.

**Do You Know How?**

- A recipe calls for 15 oz of flour for every 8 oz of milk.
  - Is the relationship between ounces of flour and ounces of milk proportional? Explain.

30oz flour  $\rightarrow$  16 oz milk

b. If you use 15 oz of milk, how much flour should you use?

$$\frac{15 \text{ f}}{8 \text{ m}} = \frac{? \text{ f}}{15 \text{ m}}$$

7.5oz flour  $\leftarrow$  4oz milk

If we use 15oz of milk, we should use 28.125oz of flour.

- A food packing company makes a popular fruit cocktail. To ensure a good mixture of fruit, there are 3 cherry halves for every 8 white grapes in a jar. An inspector notices that one jar has 12 cherry halves and 20 white grapes. What can be done to fix the error?

$$\frac{3 \text{ c}}{8 \text{ g}} \times 4 = \frac{12 \text{ c}}{? \rightarrow 32 \text{ g}}$$

The inspector can recommend

that an extra 12 white grapes be added to each jar.

Name: \_\_\_\_\_

**Practice & Problem Solving**

In 6 and 7, determine whether you can use proportional reasoning and then solve.

6. If Hector is 8 years old and Mary is 3 years old, how old will Mary be when Hector is 16?

7. Marco needs to buy some cat food. At the nearest store, 3 bags of cat food cost \$15.75. How much would Marco spend on 5 bags of cat food?

8)  $\frac{\text{model}}{\text{actual}} \rightarrow \frac{\frac{1}{3} \text{ in}}{\frac{1}{4} \text{ ft}}$   
 see notes

8. An architect makes a model of a new house with a patio made with pavers. In the model, each paver in the patio is  $\frac{1}{3}$  in long and  $\frac{1}{4}$  in wide. The actual dimensions of the pavers are shown.

a. What is the constant of proportionality that relates the length of a paver in the model and the length of an actual paver?  
 $k = \frac{4}{3}$

b. What is the constant of proportionality that relates the area of a paver in the model and the area of an actual paver? Explain your reasoning.  
 $\frac{1}{2} \cdot \frac{45}{1} = 22\frac{1}{2}$  "drop-ins" + 40 =  $62\frac{1}{2}$

9. Reasoning The table lists recommended amounts of food to order for 25 guests. Nathan is hosting a graduation party for 40 guests. There will also be guests stopping by for a short time. For ordering purposes, Nathan will count each of the 45 "drop-in" guests as half a guest. How much of each food item should Nathan order?

Item	Amount
Fried Chicken	24 pieces
Deli Meats	3 $\frac{1}{2}$ pounds
Lasagna	10 $\frac{1}{2}$ pounds

Party Food

10. Emily and Andy each go to a hardware store to buy wire. The table shows the relationship between the cost and the length of wire.

a. Emily needs 24 feet of wire. How much will she spend on wire?  
 $\$0.04 \times 12 = \$0.48 \text{ per ft} \times 24$

b. Andy needs 13 yards of wire. How much will he spend on wire?  
 $\$0.04 \times 12 \times 3 = \$1.44 \text{ per yd} \times 13$

Length in Inches (x)	Cost in Dollars (y)
120	\$4.80
135	\$5.40
150	\$6.00
175	\$7.00

Cost of Wire

Cost = \$0.04 per inch

Andy will need to spend \$18.72 on 13 yd of wire.

Emily will spend \$11.52 on 24 feet of wire.

$P = 2L + 2W$

$A_{\text{model}} = L \cdot W$

Total guests =  $62\frac{1}{2}$

for 25 people

$62\frac{1}{2} \div 25$

$2.5$  groups (food)

8) a)  $\frac{\frac{1}{3} \text{ in}}{\frac{1}{4} \text{ ft}}$

$\frac{1}{3} \div (\frac{1}{4})$

$\frac{1}{3} \times \frac{4}{1}$

$k = (\frac{4}{3}) \text{ or } 1\frac{1}{3}$

$y = kx$   
 $y = \frac{4}{3}x$

b) model area  
 $\frac{1}{3} \text{ in} \times \frac{1}{6} \text{ in}$

$A_{\text{model}} = \frac{1}{18} \text{ in}^2$

Actual Area

$A = \frac{1}{4} \text{ ft} \times \frac{1}{8} \text{ ft}$

$A = \frac{1}{32} \text{ ft}^2$

$k = \frac{\frac{1}{18}}{\frac{1}{32}}$

$\frac{1}{18} \div (\frac{1}{32})$

$\frac{1}{18} \times \frac{32}{1}$

$k = \frac{16}{9} \text{ or } 1\frac{7}{9}$

11. **Make Sense and Persevere** The weights of Michael's and Brittney's new puppies are shown in the table and graph. Whose dog gains weight more quickly? Explain.

Age (months)	1	2	3
Weight (pounds)	3.6	17.2	25.8

Michael's puppy gains 8.6 lb per month.

12. **Higher Order Thinking** Marielle's painting has the dimensions shown. The school asks her to paint a larger version that will hang in the cafeteria. The larger version will be twice the width and twice the height. Is the area of the original painting proportional to the area of the larger painting? If so, what is the constant of proportionality?

Original:  $A = l \cdot w = 24 \text{ in} \times 18 \text{ in} = 432 \text{ in}^2$

Larger:  $48 \text{ in} \times 36 \text{ in} = 1728 \text{ in}^2$

**Assessment Practice**

13. Yesterday, Zoe mixed herself a drink of pomegranate juice and more water. Today she used less pomegranate juice and more water.
- PART A**  
Which describes how the taste of today's drink compares to the taste of yesterday's drink?
- Weaker
  - Stronger
  - Equally strong
  - There is not enough information.

**PART B**  
Explain your reasoning.

Handwritten calculations:

$$\frac{155}{1} \quad \frac{310}{2} \quad \frac{465}{3}$$

$$155 \quad 155 \quad 155$$

$$4 \overline{) 155.000}$$

$$\begin{array}{r} 38 \\ -144 \\ \hline 110 \\ -96 \\ \hline 140 \end{array}$$

$$9.68 \approx 9.7$$

$$\begin{array}{r} 46 \\ \times 7 \\ \hline 112 \\ \times 8 \\ \hline 16 \end{array}$$

$$\begin{array}{r} 4 \\ \times 36 \\ \hline 288 \\ +1440 \\ \hline 1,728 \text{ in}^2 \end{array}$$

$$\begin{array}{r} 4 \\ 432 \overline{) 1728} \\ -1728 \\ \hline 0 \end{array}$$
