# UNIT 2

## Rate, Ratio, and Proportional Reasoning Using Equivalent Fractions


## Essential Question

HOW can you use mathematics to describe change and model real-world situations?



Chapter 3

### Ratios and Rates

A ratio is a comparison of two quantities by division. In this chapter, you will explore ratio concepts and use ratio reasoning to solve rate problems.



Chapter 4

### Fractions, Decimals, and Percents

Equivalent forms of fractions, decimals, and percents can be written and used to solve problems. In this chapter, you will apply these relationships to solve percent problems.

# Chapter 3
# Ratios and Rates

Martin Harvey/Gallo Images/Getty Images



## Essential Question

**HOW do you use equivalent rates in the real world?**

## Common Core GPS

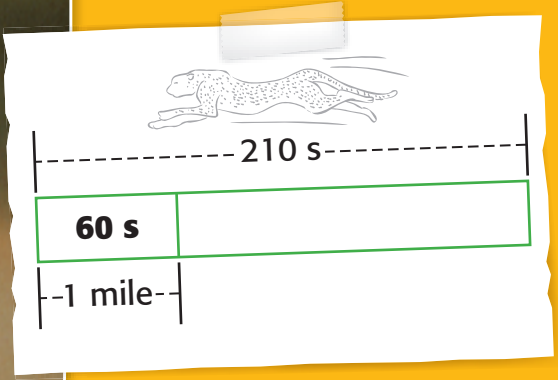
**Content Standards**
MCC6.RP.1, MCC6.RP.2, MCC6.RP.3, MCC6.RP.3a, MCC6.RP.3b, MCC6.NS.4

**Mathematical Practices**
1, 3, 4, 5, 6, 7, 8

## Math in the Real World

**Cheetahs** are the fastest land animals. They can chase prey by running at speeds of 60 miles per hour.

A cheetah can only maintain top speeds for a short time. If a cheetah runs 1 mile in 60 seconds, fill in the diagram to show how far the cheetah will run in 210 seconds.




**FOLDABLES® Study Organizer**

1. Cut out the correct Foldable from the FL pages in the back of this book.
2. Place your Foldable on the Key Concept page toward the end of this chapter.
3. Use the Foldable throughout this chapter to help you learn about ratios and rates.

# What Tools Do You Need?

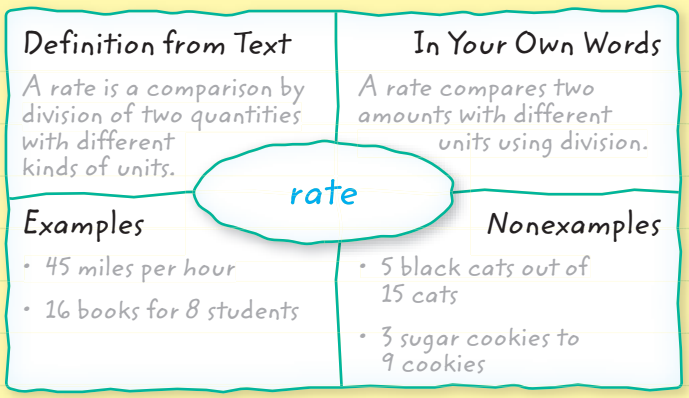
## Vocabulary

| | | |
|---|---|---|
| coordinate plane | rate | *x*-axis |
| equivalent ratio | ratio | *x*-coordinate |
| graph | ratio table | *y*-axis |
| ordered pair | scaling | *y*-coordinate |
| origin | unit price | |
| prime factorization | unit rate | |

## Study Skill: Studying Math

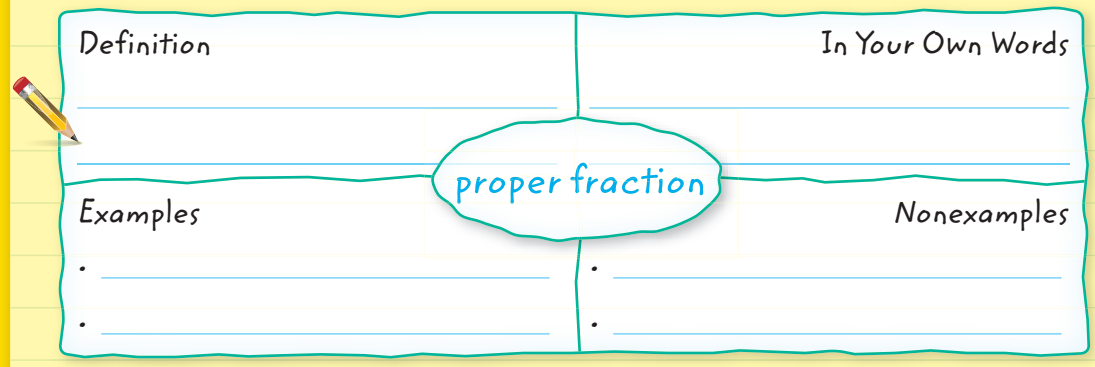
**New Vocabulary** New vocabulary terms are clues about important concepts. Learning new vocabulary words is more than just memorizing the definition. Whenever you see a new vocabulary word, ask yourself:

- How does this fit with what I already know?
- How is this alike or different from something I learned earlier?




Organize your answers in a word map like the one shown.

Make a word map for *proper fraction*.



# When Will You Use This?


**Your Turn!** You will solve this problem in the chapter.

# Are You Ready?

Try the Quick Check below.
Or, take the Online Readiness Quiz.

## Quick Review

**Common Core Review** MCC5.NBT.6, MCC5.NF.5b

### Example 1

**Find $6\overline{)348}$.**

$$\begin{array}{r} 58 \\ 6\overline{)348} \\ -30 \\ \hline 48 \\ -48 \\ \hline 0 \end{array}$$

Divide each place-value position from left to right.

Since 48 – 48 = 0, there is no remainder.

### Example 2

**Write $\frac{40}{64}$ in simplest form.**

$$\frac{40}{64} \overset{\div 8}{=} \frac{5}{8}$$

Divide the numerator and denominator by the greatest common factor (GCF), 8.

Since the GCF of 5 and 8 is 1, the fraction $\frac{5}{8}$ is in simplest form.

## Quick Check

**Divide Whole Numbers** **Find each quotient.**

**1.** $3\overline{)87}$

Show your work.

**2.** $8\overline{)584}$

**3.** $52\overline{)312}$

**Simplify Fractions** **Write each fraction in simplest form.**

**4.** $\frac{32}{48} =$ _____

**5.** $\frac{7}{28} =$ _____

**6.** $\frac{15}{25} =$ _____

**7.** An airplane has flown 260 miles out of a total trip of 500 miles. What fraction, in simplest form, of the trip has been completed?

_____

## How Did You Do?

**Which problems did you answer correctly in the Quick Check? Shade those exercise numbers below.**

1 2 3 4 5 6 7

# Inquiry Lab
## Ratios

**Inquiry** **HOW can you use tables to relate quantities?**

**Content Standards**
MCC6.RP.1, MCC6.RP.3, MCC6.RP.3a

**Mathematical Practices**
1, 3, 4

**Donations** Max has 3 fiction books and 6 nonfiction books to donate to the community center. He wants to package them so that there are an equal number of fiction and nonfiction books in each group. He also wants to have as many packages as possible. How many books are in each group?

What do you know? _____

_____

_____

What do you need to find? _____

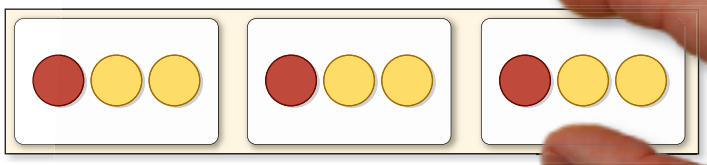
_____

## Investigation 1

Tools

**Step 1** Use 3 red counters to represent the fiction books. Use 6 yellow counters to represent the nonfiction books.

**Step 2** Determine the smallest possible equal-size groups. Use mats to divide the counters into the groups.



Each group has an equal number of fiction books and an equal number of nonfiction books.

Each group has ☐ fiction book and ☐ nonfiction books.

## Investigation 2

**Donations** Maria is also collecting books. She wants to make packages that have 3 fiction books and 4 nonfiction books. She already has 9 fiction books. How many nonfiction books will she need?

Use a multiplication table to compare the numbers.

**Step 1** Complete the rows for 3 and 4 on a multiplication table.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| fiction → | 3 | 6 | | | | | | | | |
| nonfiction → | 4 | 8 | | | | | | | | |

**Step 2** Read across the top until you reach 9. Find the corresponding number in the bottom row and circle the 2 numbers.

Maria needs ____ nonfiction books.

## Investigation 3

**Sports Jerseys** Sanjay has 27 jerseys. Divide them into two groups so that for every 4 red jerseys, there are 5 blue jerseys.

**Step 1** Complete the rows for 4 and 5 on a multiplication table.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| red → | 4 | 8 | | | | | | | | |
| blue → | 5 | 10 | | | | | | | | |

**Step 2** Read across both rows until you find two numbers with a sum of 27.

There are ____ red jerseys and ____ blue jerseys.

Check Draw a picture to check your answer.

## Collaborate

**Work with a partner. Determine the number of pieces of fruit that should be put in each group. Make as many equal-size groups as possible using all the fruit. Use counters to represent the fruit.**

**1.** 3 apples and 9 pears

**2.** 4 peaches and 6 oranges

Show your work.

**3.** 4 plums and 7 bananas

**4.** 6 apricots and 9 mangos

**Work with a partner. Use a multiplication table to solve the following problems.**

**5.** Evie wants groups of 3 notebooks and 5 pens. She already has 12 notebooks. How many pens will she need?

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **notebooks** → | | | | | | | | | | |
| **pens** → | | | | | | | | | | |

**6.** Louis wants groups of 6 daisies and 8 tulips for flower arrangements. He already has 24 daisies. How many tulips will he need?

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **daisies** → | | | | | | | | | | |
| **tulips** → | | | | | | | | | | |

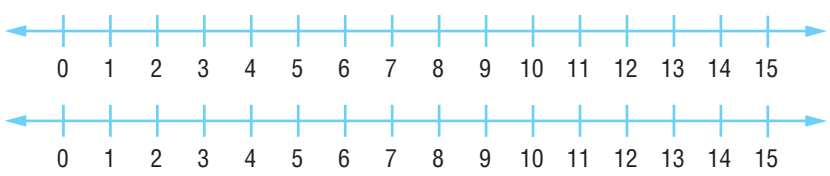
**7.** Selma has 77 strawberries. Divide them into two groups so that for every 4 strawberries in Group 1 there are 7 strawberries in Group 2.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Group 1** → | | | | | | | | | | |
| **Group 2** → | | | | | | | | | | |

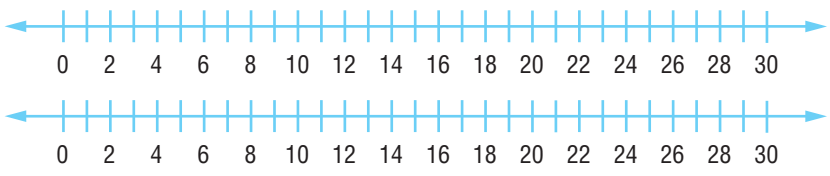
## Analyze

**Model with Mathematics** **Work with a partner. For each fraction, plot the nonzero multiples of the numerator and the denominator on separate number lines. Circle the least common multiple.**

**8.** $\frac{2}{3}$



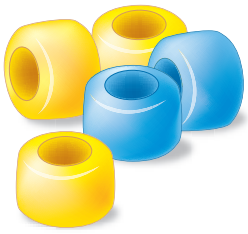

**9.** $\frac{3}{4}$




**10.** **Reason Inductively** How would finding the least common multiple help you when dividing items into equal groups?

## Reflect

**11.** **Model with Mathematics** Write a word problem in which the ratio of yellow beads to blue beads is 3 to 2.



**12.** **Identify Repeated Reasoning** Describe the patterns used in the tables in Investigations 2 and 3.

**13.** Inquiry HOW can you use tables to relate quantities?

# Ratios

**What You'll Learn**

Scan the lesson. List two real-world scenarios in which you would use ratios.

- _____
- _____

**Essential Question**

HOW do you use equivalent rates in the real world?

**Vocabulary**

ratio

**Common Core GPS**

**Content Standards**
MCC6.RP.1, MCC6.RP.3

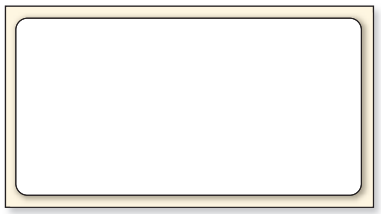
**Mathematical Practices**
1, 3, 4, 5

## Real-World Link

Watch Tools

**Dogs** In her dog walking business, Mrs. DeCarbo walks 2 large dogs and 8 small dogs.

Compare the number of small dogs to large dogs. Use yellow counters to represent the large dogs. Use red counters to represent the small dogs. Draw the counters in the box.



Brand X Pictures/Getty Images

**1.** $2 + \square = 8$ There are $\square$ *more* small dogs than large dogs.

**2.** $2 \times \square = 8$ There are $\square$ *times* as many small dogs as large dogs.

**3.** $8 - \square = 2$ There are $\square$ *fewer* large dogs than small dogs.

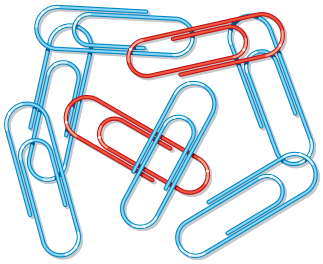
**4.** $8 \div \square = 2$ The number of large dogs is $\frac{\square}{\square}$ the number of small dogs.

Work Zone

# Write a Ratio in Simplest Form

There are many different ways to compare amounts or *quantities*. A **ratio** is a comparison of two quantities by division. A ratio of 2 red paper clips to 6 blue paper clips can be written in three ways.

**2 to 6** **2:6** $\frac{2}{6}$

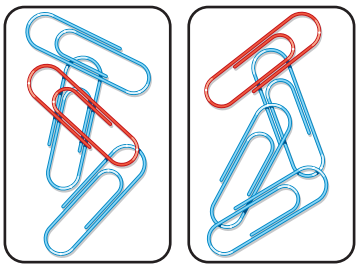


As with fractions, ratios are often expressed in simplest form.

## Example

Tutor

**1.** **Write the ratio in simplest form that compares the number of red paper clips to the number of blue paper clips. Then explain its meaning.**



Write the ratio as a fraction. Then simplify.

red paper clips ⋯➤ $\frac{2}{6} = \frac{1}{3}$ ⋯ The GCF of 2 and 6 is 2.
blue paper clips ⋯➤

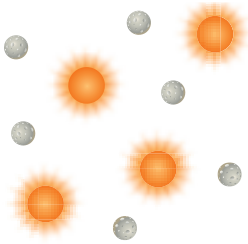
$\div 2$ above and $\div 2$ below

The ratio of red to blue paper clips is $\frac{1}{3}$, 1 to 3, or 1:3. This means that for every 1 red paper clip there are 3 blue paper clips.

Show your work.

**Got It?** **Do this problem to find out.**

**a.** Write the ratio in simplest form that compares the number of suns to the number of moons. Then explain its meaning.



a. _____

# Use Ratios to Compare Categorical Data

Each piece of categorical data can only be assigned to one group. Bar diagrams (or tape diagrams) and frequency tables can be used to represent categorical data. Ratios can be used to compare the data.

## Examples

Watch Tutor

**2.** **Several students named their favorite flavor of gum. Write the ratio that compares the number who chose fruit to the total number of students.**

| Favorite Flavor of Gum | |
|---|---|
| **Flavor** | **Number of Responses** |
| Peppermint | 9 |
| Cinnamon | 8 |
| Fruit | 3 |
| Spearmint | 1 |

Fruit: 3

Total: 9 + 8 + 3 + 1, or 21

fruit flavor responses → $\frac{3}{21} = \frac{1}{7}$ ← total responses

(÷3 above, ÷3 below)

The GCF of 3 and 21 is 3.

The ratio is $\frac{1}{7}$, 1 to 7, or 1:7.

So, 1 out of every 7 students preferred fruit-flavored gum.

**3.** **Monday's yogurt sales are recorded in the table. Write the ratio that compares the sales of strawberry yogurt to the total sales. Then explain its meaning.**

| Flavor | Number Sold |
|---|---|
| Peach | 3 |
| Blueberry | 6 |
| Vanilla | 7 |
| Strawberry | 8 |

Strawberry: ☐

Total: ☐ + ☐ + ☐ + ☐, or ☐

strawberry yogurt sold → $\frac{\square}{\square} \div \frac{\square}{\square} = \frac{\square}{\square}$ or ☐ to ☐ ← total sold

So, ☐ out of every ☐ yogurt cups sold were strawberry.

**Got It?** **Do this problem to find out.**

**b.** A pet store sold the animals listed in the table in one week. Write the ratio of cats to pets sold that week. Then explain its meaning.

| Pet | Number Sold |
|---|---|
| Birds | 10 |
| Dogs | 14 |
| Cats | 8 |

**Accuracy**
It is important to read the entire problem so that an accurate answer can be determined.

Show your work.

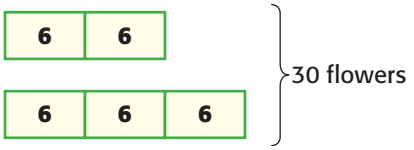
b. _____

## Example

Watch Tutor

**4.** **Katy wants to divide her 30 flowers into two groups, so that the ratio is 2 to 3.**

**Step 1** Use a bar diagram to show a ratio of 2 to 3.




**Step 2** There are 5 equal sections. So, each section represents 30 ÷ 5 or 6 flowers.

There are 12 flowers in one group and 18 in the other.

## Guided Practice

Check

**Write each ratio as a fraction in simplest form. Then explain its meaning.** (Example 1)

**1.** _____

Show your work.

pens to pencils

**2.** _____

pennies:dimes

**3.** Last month, Ed ate 9 apples, 5 bananas, 4 peaches, and 7 oranges. Find the ratio of bananas to the total number of fruit. Then explain its meaning. (Examples 2 and 3)

_____

_____

**4.** Divide 28 cans of soda into two groups so the ratio is 3 to 4. (Example 4) _____

_____

**5.** **Building on the Essential Question** How can you use mental math to determine if a ratio is simplified?

_____

_____

### Rate Yourself!

How confident are you about ratios? Shade the ring on the target.


For more help, go online to access a Personal Tutor.

Tutor

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

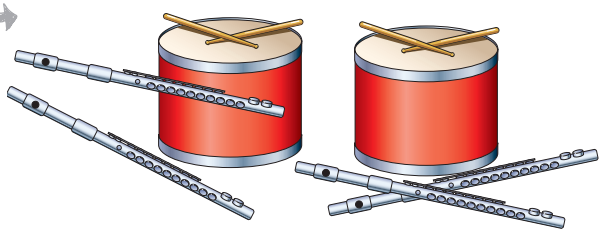
# Independent Practice

Go online for Step-by-Step Solutions eHelp

**Write each ratio as a fraction in simplest form. Then explain its meaning.** (Example 1)

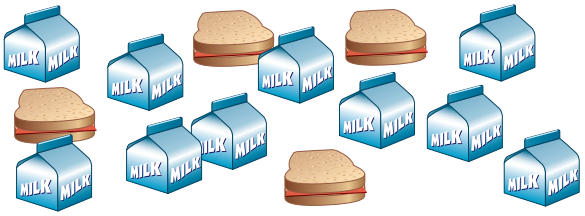
**1.** _____

Show your work.



flutes:drums

**2.** _____




sandwiches to milk cartons

**3** A class has 6 boys and 15 girls. What is the ratio of boys to girls?

(Example 2) _____

**4.** The table shows the number of books Salvador has read. Find the ratio of mystery books to the total. Explain its meaning. (Example 3)

_____

| Type | Number of Books |
|---|---|
| Mystery | 10 |
| Nonfiction | 7 |
| Science Fiction | 5 |
| Western | 2 |

**5.** Divide 33 photos into two groups so the ratio is 4 to 7. (Example 4)

_____

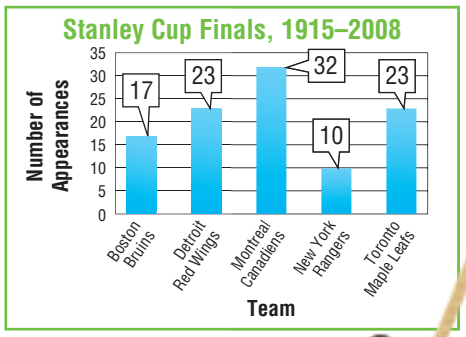
**6.** CCSPS **Model with Mathematics** Refer to the graphic novel frame below for Exercises a–b.


**a.** For each store, what is the ratio of the number of cans to the price?

_____

**b.** What would be the ratio of the number of cans to the price at Super Saver and Price Busters if a coupon for $1 off the total purchase is used? _____

**7** **Use Math Tools** The graph shows the number of appearances of hockey teams in the Stanley Cup Finals.




**a.** Write the ratio that compares the appearances made by the Rangers to the appearances made by the Canadiens in simplest form. Then explain its meaning.

**b.** Write the ratio that compares the appearances made by the Maple Leafs to the appearances made by the Bruins in simplest form. Then explain its meaning.

## H.O.T. Problems Higher Order Thinking

**8.** **Model with Mathematics** Create three different drawings showing a number of circles and triangles in which the ratio of circles to triangles is 2:3.

Show your work.

**9.** **Persevere with Problems** Find the missing number in the following pattern. Explain your reasoning.

12, 24, 72, 288, ☐

## Georgia Test Practice

**10.** The table shows how Levon spends his time at the gym. What is the ratio of the time on the treadmill to the time lifting weights?

| Activity | Time (min) |
|---|---|
| Treadmill | 25 |
| Lifting weights | 35 |

Ⓐ 2 to 3 Ⓒ 4 to 5

Ⓑ 5 to 7 Ⓓ 1 to 7

Name _____ My Homework _____

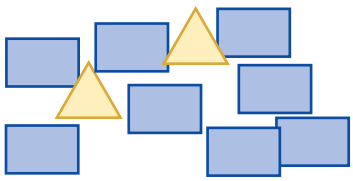
# Extra Practice

**Write each ratio as a fraction in simplest form. Then explain its meaning.**

**11.** $\frac{1}{4}$; for every 1 triangle there are 4 rectangles.

**12.** _____

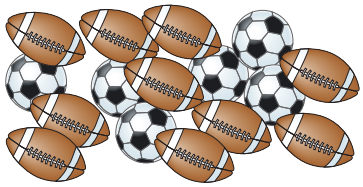
Homework Help



triangles to rectangles

There are 2 triangles and 8 rectangles.

The ratio is $\frac{2}{8}$. $\frac{2}{8} \div \frac{2}{2} = \frac{1}{4}$



soccer balls:footballs

**13.** An animal shelter has 36 kittens and 12 puppies available for adoption. What is the ratio of puppies to kittens?

_____

**14.** Find the ratio of black cell phone covers sold to the total number of cell phone covers sold last week. Then explain its meaning.

_____

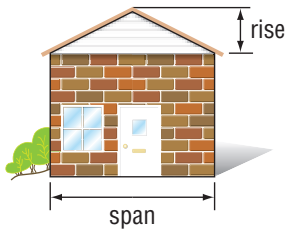
| Color | Number of Cell Phone Covers Sold |
|---|---|
| Green | 5 |
| Silver | 6 |
| Red | 3 |
| Black | 4 |

**15.** On the first day of the food drive, Mrs. Teasley's classes brought in 6 cans of fruit, 4 cans of beans, 7 boxes of noodles, and 4 cans of soup. Find the ratio of cans of fruit to the total number of food items collected. Then explain its meaning.

_____

_____

**16.** The rise and span for a roof are shown. The pitch of a roof is the ratio of the rise to the half-span. If the rise is 8 feet and the span is 30 feet, what is the pitch in simplest form?




_____

_____

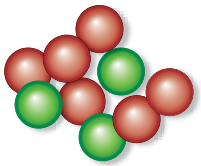
**17.** CCSPS **Justify Conclusions** Debra found that 6 of the 24 students in her class own a cell phone. What is the ratio of students that own a cell phone to students that do not? Explain your reasoning to a classmate.

_____

_____

## Georgia Test Practice

**18.** Which of the following ratios does *not* describe a relationship between the balls?



Ⓐ 3 green : 6 red
Ⓑ 3 green : 9 total
Ⓒ 1 green : 2 red
Ⓓ 1 red : 4 total

**19.** Of new calculators tested, 8 were defective, and 42 passed inspection. What ratio compares the number of defective calculators to the total number of new calculators?

Ⓕ 4:21
Ⓖ 4:25
Ⓗ 1:25
Ⓘ 2:13

**20.** **Short Response** Jaclyn counted the number of sport cards she has collected. The table shows the results.

| baseball | basketball | football | soccer |
|---|---|---|---|
| 45 | 14 | 20 | 21 |

Write a ratio in simplest form that compares the number of basketball cards to the number of soccer cards.

**21.** At a putt-putt course there are 50 yellow golf balls, 45 red golf balls, and 65 blue golf balls. What ratio compares the number of blue golf balls to the total number of golf balls?

Ⓐ 13:9
Ⓑ 13:32
Ⓒ 32:9
Ⓓ 16:5

## Common Core Review

**Find the equivalent fraction.** MCC5.NF.5b

**22.** $\frac{3}{7} = \frac{\square}{21}$

**23.** $\frac{1}{6} = \frac{\square}{24}$

**24.** $\frac{4}{5} = \frac{28}{\square}$

**25.** The Sanchez family is going on vacation. If they drive for 3 hours at the posted speed, how many miles will they travel? MCC5.NBT.5


**26.** Everett made $\frac{3}{5}$ of the baskets he shot. Suppose he shot 60 baskets. How many did he make? MCC5.NF.4

**27.** There are 36 students in Mrs. Keaton's sixth grade class. If $\frac{5}{12}$ of her students are girls, how many girls are in the class? MCC5.NF.4

# Inquiry Lab
## Unit Rates

**Inquiry** **HOW can you use bar diagrams to compare quantities in real-world situations?**

**Content Standards**
MCC6.RP.2, MCC6.RP.3, MCC6.RP.3b

**Mathematical Practices**
1, 3, 8

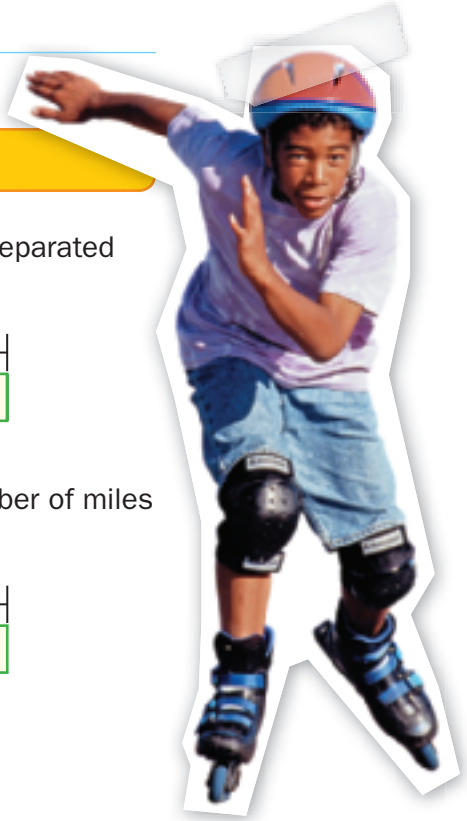
**Rollerblading** Jamila and Anica were rollerblading. They skated 14 miles in 2 hours. If they skated at a constant rate, how many miles did they skate in 1 hour?

What do you know? _____

_____

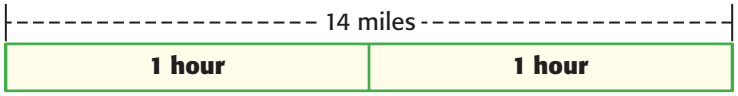
What do you need to find? _____

_____

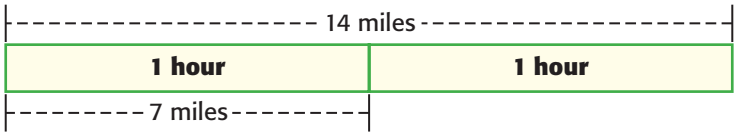


## Investigation 1

**Step 1** Use a bar diagram to represent 14 miles. The box is separated into two equal sections to represent 2 hours.




**Step 2** Each section represents one hour. Determine the number of miles skated in one hour.

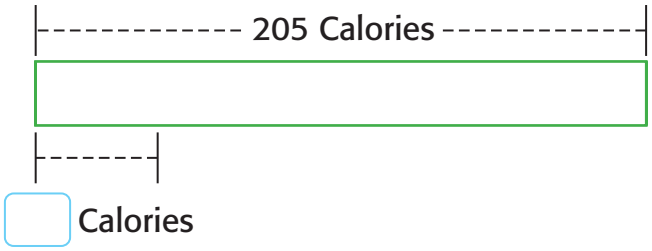



So, they skated ☐ miles in one hour.

## Investigation 2

**A package of 5 crackers contains 205 Calories. How many Calories are in one cracker?**

**Step 1** Draw a bar diagram to represent 205 Calories. Divide the bar diagram into 5 equal sections to represent 5 crackers.



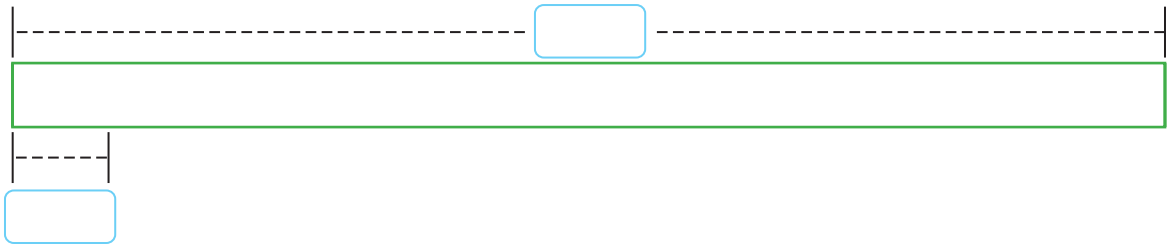

**Step 2** Label the first section "1 cracker." Determine the number of Calories in 1 cracker.

So, one cracker contains ____ Calories.

## Investigation 3

**A bottle of body wash costs $2.88 and contains 12 ounces. How much does it cost per ounce?**

**Step 1** Draw a bar diagram to represent _____. Divide the bar diagram into ____ equal sections to represent ____ ounces.



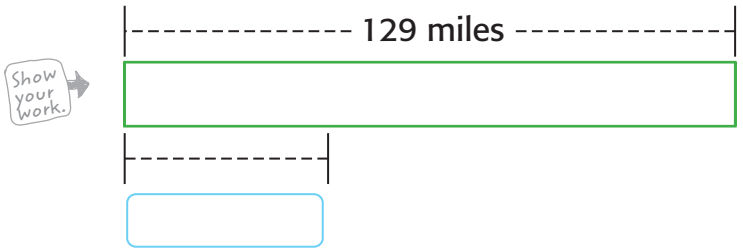
**Step 2** Label the first section "_____." Determine the cost for 1 ounce of body wash.

So, one ounce of body wash costs $____.

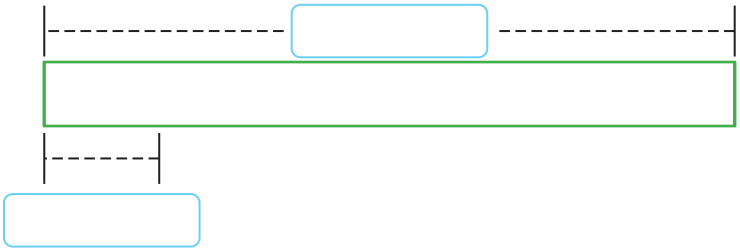
## Collaborate

**Work with a partner to solve. Use a bar diagram.**

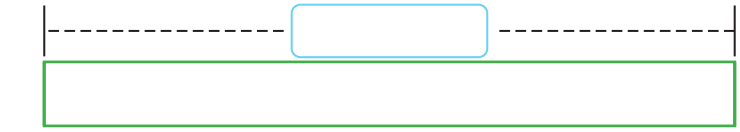
**1.** Travis drove 129 miles in 3 hours. He drove at a constant speed. How many miles did he drive in 1 hour? _____




**2.** Six oranges cost $5.34. How much does 1 orange cost? _____

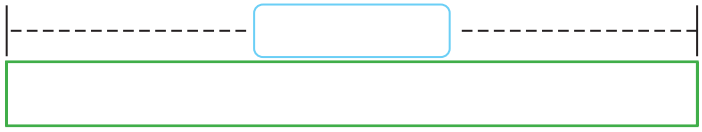


**3.** Doug read 231 pages in 7 hours. He read the same number of pages each hour. How many pages did he read in 1 hour? _____



☐ pages

**4.** Mariah has 72 flowers in 4 vases. She put the same number of flowers in each vase. How many flowers are in 1 vase? _____



☐ flowers

## Analyze

**Work with a partner to complete the problem.**

**5.** In the bakery, a container of cookies is $4.55 and contains 13 servings. The coins below equal $4.55. Divide the coins into 13 equal groups to determine the cost per serving. Circle each group.

**6.** **Reason Inductively** How does dividing the coins into equal groups help solve the problem?

## Reflect

**7.** **Justify Conclusions** The ratio of miles to hours in Investigation 1 is 14:2, which can be reduced to 7:1. How is simplifying the ratio similar to division?

**8.** **Identify Repeated Reasoning** Write a rule for how to find a ratio with a denominator of 1 without using a diagram.

**9.** Inquiry HOW can you use bar diagrams to compare quantities in real-world situations?

**What You'll Learn**

Scan the lesson. List two real-world scenarios in which you would use rates.

- _____
- _____

**Essential Question**

HOW do you use equivalent rates in the real world?

**Vocabulary**

rate
unit rate
unit price

**Common Core GPS**

**Content Standards**
MCC6.RP.2, MCC6.RP.3, MCC6.RP.3b

**Mathematical Practices**
1, 3, 4

## Vocabulary Start-Up

**Use your glossary, which starts on page GL1, to complete the definitions of the vocabulary words in the table.**

| Definition | Examples |
|---|---|
| **fraction:** A number that represents part of a _____ or part of a _____. | $\frac{1}{2}, \frac{3}{4}, \frac{9}{12}, \frac{45}{3}$ |
| **ratio:** A comparison of two _____ by _____. | 2 out of 3, 2 to 3, 2:3, $\frac{2}{3}$ |
| **rate:** A _____ comparing two _____ with different kinds of _____. | $\frac{36 \text{ miles}}{3 \text{ hours}}$<br>36 miles for every 3 hours<br>$26 for 5 bags<br>19 songs in 5 minutes |
| **unit rate:** A _____ that is _____ so that it has a denominator of _____. | $\frac{12 \text{ miles}}{1 \text{ hour}}$, 12 miles per hour<br>$5.20 for 1 bag<br>3.8 songs in 1 minute |

## Real-World Link

Desiree typed a 15-character text message in 5 seconds.

1. Write the rate Desiree typed as a fraction. $\frac{\square \text{ characters}}{\square \text{ seconds}}$

2. What operation would you use to write the fraction in simplest form? _____

Punchstock/Brand X Pictures

Work Zone

# Find a Unit Rate

A **rate** is a ratio comparing two quanities of different kinds of units. A **unit rate** has a denominator of 1 unit when the rate is written as a fraction. To write a rate as a unit rate, divide the numerator and the denominator of the rate by the denominator.

| Ratio | Rate | Unit Rate |
|---|---|---|
| $15:5 = \frac{15 \text{ characters}}{5 \text{ seconds}}$ | $= \frac{3 \text{ characters}}{1 \text{ second}}$ | |

## Examples

Tutor

**1.** **Samantha picked 45 oranges in 5 minutes. Write this rate as a unit rate.**

Write the rate as a fraction. Compare the number of oranges to the number of minutes. Then divide.

$$\frac{45 \text{ oranges}}{5 \text{ minutes}} \overset{\div 5}{=} \frac{9 \text{ oranges}}{1 \text{ minute}}$$

So, the unit rate is $\frac{9 \text{ oranges}}{1 \text{ minute}}$, or 9 oranges per minute.

**Simplifying Ratios**

The lowest common factor of 3 and 5 is 1. To find the unit rate of the ratio $\frac{3 \text{ miles}}{5 \text{ minutes}}$, divide both the numerator and denominator by 5. So, the unit rate in fration form is $\frac{3}{5}$ mile per minute.

**2.** **The Australian dragonfly can travel 18 miles in 30 minutes. How far can the dragonfly travel in 1 minute?**

Write the rate as a fraction. Compare the distance to the number of minutes. Then divide.

$$\frac{18 \text{ miles}}{30 \text{ minutes}} \overset{\div 6}{=} \frac{3 \text{ miles}}{5 \text{ minutes}}$$

The ratio 3 to 5 cannot be simplified to a whole number rate. It can be written as $\frac{3 \text{ miles}}{5 \text{ minutes}}$ or as a unit rate of $\frac{3}{5}$ mile to 1 minute.

The dragonfly can travel $\frac{3}{5}$ mile every minute.

Show your work.

**Got It?** **Do this problem to find out.**

a. _____

b. _____

**a.** Ama downloaded 35 songs in 5 minutes. How many songs did she download per minute?

**b.** Jonathan is baking several loaves of bread to sell in his bakery. He used 9 cups of water and 12 cups of whole wheat flour. How much water was used per cup of flour?

## Example

Tutor

**3.** **An adult's heart beats about 2,100 times every 30 minutes. A baby's heart beats about 2,600 times every 20 minutes. How many more beats does a baby's heart beat in 60 minutes than an adult's heart?**

**Step 1** Find the unit rates.

Adult: $\frac{2{,}100 \text{ beats}}{30 \text{ minutes}}$ or $\frac{70 \text{ beats}}{1 \text{ minute}}$

Baby: $\frac{2{,}600 \text{ beats}}{20 \text{ minutes}}$ or $\frac{130 \text{ beats}}{1 \text{ minute}}$

**Step 2** Using the unit rate for each, determine the number of beats in 60 minutes.

Adult: $70 \times 60 = 4{,}200$ beats

Baby: $130 \times 60 = 7{,}800$ beats

**Step 3** Find the difference.

$7{,}800 - 4{,}200 = 3{,}600$

So, a baby's heart beats 3,600 more times in 60 minutes than an adult's heart.

**Key Phrases**

Key phrases such as *per*, *in*, and *for every* are often used to describe unit rates.

**Got It?** **Do this problem to find out.**

Show your work.

**c.** A hummingbird's heart rate while resting is about 7,500 beats every 30 minutes. How many more beats does a hummingbird's heart beat in 60 minutes than a human baby's heart?

c. _____

## Find a Unit Price

You can use what you know about unit rates to find a unit price. The **unit price** is the cost per unit. To write a price as a unit price, divide the numerator and the denominator of the rate by the denominator.

$$\frac{\$36}{4 \text{ tickets}} = \frac{\$9}{1 \text{ ticket}}$$

(÷4 above and ÷4 below)

For example, it costs \$36 for 4 movie tickets. So, the cost per unit, or per ticket, is \$9.

## Example

**4.** **Financial Literacy** **Four potted plants cost $88. What is the price per plant?**

Write the rate as a fraction. Compare the total cost to the number of plants. Then divide.

$$\frac{\$88}{4 \text{ plants}} \overset{\div 4}{=} \frac{\$22}{1 \text{ plant}}$$

So, the price per potted plant is $22.00.

## Guided Practice

**Write each rate as a unit rate.** (Examples 1 and 2)

**1.** 44 points in 4 quarters = _____

Show your work.

**2.** 125 feet in 5 seconds = _____

**3.** 360 miles traveled on 12 gallons of gasoline = _____

**4.** 12 meters in 28 seconds = _____

**5.** Molly shot 20 baskets in 4 minutes. Nico shot 42 baskets in 6 minutes. How many more baskets did Nico shoot per minute? (Example 3) _____

**6.** For Carolina's birthday, her mom took her and 4 friends to a water park. Carolina's mom paid $40 for 5 student tickets. What was the price for one student ticket? (Example 4)

_____

**7.** **Building on the Essential Question** How are rates and ratios related? _____

_____

_____

_____

### Rate Yourself!

☐ I understand how to find a unit rate.

Great! You're ready to move on!

☐ I still have some questions about rates.

No Problem! Go online to access a Personal Tutor.

Name _____ My Homework _____

# Independent Practice

Go online for Step-by-Step Solutions eHelp

**Write each rate as a unit rate.** (Examples 1 and 2)

**1.** 72 ounces in 6 steaks = _____

Show your work.

**2.** 162 water bottles in 9 cases = _____

**3** Marcella divided 40.8 gallons of paint among 8 containers. How much paint is in each container? (Example 1) _____

**4.** Central Subs made 27 sandwiches using 12 pounds of turkey. How much turkey was used per sandwich? (Example 2)

_____

**5.** The results of a car race are shown. Determine who drove the fastest. Explain.

(Example 3) _____

_____

_____

_____

| Drivers' Times | | |
|---|---|---|
| **Driver** | **Laps** | **Time (min)** |
| Cutwright | 35 | 84 |
| Evans | 42 | 96.6 |
| Loza | 38 | 102.6 |

**6.** Theo's mom bought an eight-pack of juice boxes at the store for $4. Find the unit rate for the juice boxes. (Example 4) _____

_____

**7.** Joshua's cousin pledged $12 for a charity walk. If Joshua walked 3 miles, how much did his cousin pay per mile? (Example 4)

_____

**8.** CCSPS **Justify Conclusions** The Lovin' Lemon Company sells a 4-gallon jug of lemonade for $24. The Sweet and Sour Company sells an eight-pack of 1-quart bottles of lemonade for $16.00. Which company has a higher unit price? Explain your answer.

_____

**9** The Shanghai Maglev Train is one of the fastest trains in the world, traveling about 2,144 miles in 8 hours.

**a.** How many miles does it travel in one hour? _____

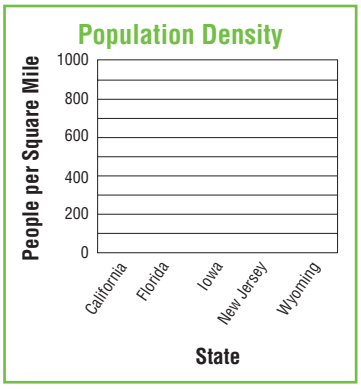
**b.** The distance between Columbus, Ohio, and New York City is about 560 miles. How many hours would it take the train to travel between the cities? _____

**10.** **Multiple Representations** The table shows the approximate population and areas of five states. *Population density* is the number of people per square unit of an area.

| State | Population Estimate (as of July 2007) | Area (square miles) |
|---|---|---|
| California | 36,500,000 | 163,707 |
| Florida | 18,300,000 | 65,758 |
| Iowa | 2,990,000 | 56,276 |
| New Jersey | 8,690,000 | 8,722 |
| Wyoming | 522,000 | 97,818 |

**a. Numbers** Find the population density of each state. Round to the nearest tenth.

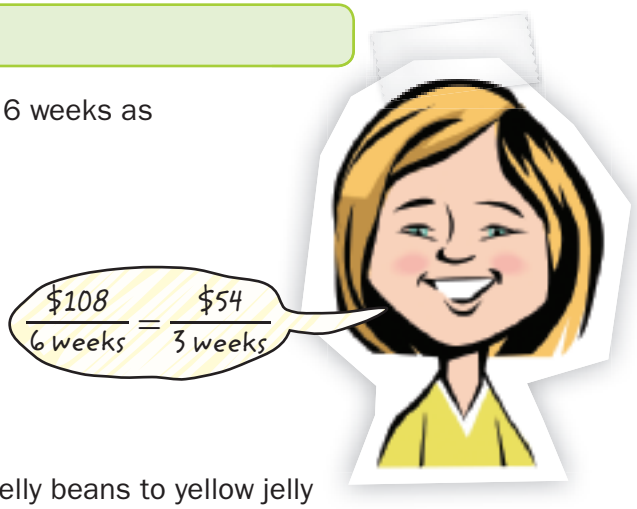
**b. Graph** Make a bar graph of the five population densities.




**c. Words** Connecticut has about the same population as Iowa, but its area is 4,875 square miles. Without calculating, compare Connecticut's population density to Iowa's. Justify your answer.

## H.O.T. Problems Higher Order Thinking

**11.** **Find the Error** Julie wrote the rate $108 in 6 weeks as a unit rate. Find her mistake and correct it.




**12.** **Persevere with Problems** The ratio of red jelly beans to yellow jelly beans in a dish is 3:4. If Greg eats 3 red jelly beans and 6 yellow ones, the ratio is 4:5. How many yellow jelly beans were originally in the dish?

## Georgia Test Practice

**13.** The human heart pumps 750 gallons of blood in 9 hours. A human kidney filters 100 gallons of blood in 6 hours. How many more gallons of blood does the human heart pump than a human kidney filters during 24 hours?

Ⓐ 2,000 Ⓑ 1,600 Ⓒ 250 Ⓓ 50

Name _____ My Homework _____

# Extra Practice

**Write each rate as a unit rate.**

**14.** Davis printed 24 photos in 8 minutes. How many photos did he print per minute?

3 photos per minute

Homework Help

$$\frac{24 \text{ photos}}{8 \text{ minutes}} \overset{\div 8}{=} \frac{3 \text{ photos}}{1 \text{ minute}}$$

**15.** Carrie planted 48 tulips in 12 minutes. How many tulips did she plant per minute?

_____

**16.** Vinnie decorated 72 cookies in 36 minutes. How many cookies did he decorate per minute?

_____

**17.** Alana biked 45 miles in 3 hours. How many miles did she bike per hour?

_____

**18.** A Ruby Throated Hummingbird beats its wings 159 times in 3 seconds. How many times does the Ruby Throated Hummingbird beat its wings per second? _____

**19.** The Reyes family bought four concert tickets for $252. What was the price per ticket? _____

**20.** An adult blinks about 450 times in 30 minutes. A 12-year-old blinks about 150 times in 15 minutes. How many more times does an adult blink in 60 minutes than a 12-year-old? _____

**21.** Find the number of meters each record holder ran in one second of each event. Round to the nearest tenth.

**a.** 200 meters, 19.30 seconds, Usain Bolt, Jamaica _____

**b.** 400 meters, 43.18 seconds, Michael Johnson, USA _____

**c.** 100 meters, 9.69 seconds, Usain Bolt, Jamaica _____

**22.** CCSPS **Justify Conclusions** The 24 students in Mr. Brown's homeroom sold 72 magazine subscriptions. The 28 students in Mrs. Garcia's homeroom sold 98 magazine subscriptions. Whose homeroom sold more magazine subscriptions per student? Explain your reasoning. _____

_____

_____

## Georgia Test Practice

**23.** Olivia printed invitations for a party. If she printed 286 invitations in 26 minutes, how many invitations did she print each minute?

Ⓐ 60 Ⓒ 11

Ⓑ 26 Ⓓ 9

**24.** Amy is training for a half marathon. In practice, she runs 2 miles in 15 minutes. If she continues at the same rate, how many miles will she run in 1 hour?

Ⓕ 4 Ⓗ 16

Ⓖ 8 Ⓘ 30

**25. Short Response** Boxes of fruit snacks are on sale at the grocery. The boxes are the same size. What is the unit rate for each kind?


**26.** Genevieve spent $56.25 to fill her 15-gallon tank. How much did she pay per gallon?

Ⓐ $3.25 Ⓒ $3.75

Ⓑ $3.50 Ⓓ $4.00

## Common Core Review

**Simplify each fraction.** MCC5.NF.5b

**27.** $\frac{16}{80} = \frac{\square}{\square}$

**28.** $\frac{4}{10} = \frac{\square}{\square}$

**29.** $\frac{48}{200} = \frac{\square}{\square}$

**30.** Josephine wants to put a wallpaper border around the ceiling of her room. The dimensions are shown at the right. How many feet of border does she need? MCC5.NF.2


**31.** Miguel's grandparents live 159 miles from his house. If it takes 3 hours to drive to his grandparent's house, what is the average speed? MCC5.NBT.5

# Ratio Tables

**What You'll Learn**

Scan the lesson. List two things you will learn about ratio tables.

- _____
- _____

**Essential Question**

HOW do you use equivalent rates in the real world?

**Vocabulary**

ratio table
equivalent ratios
scaling

**Common Core GPS**

**Content Standards**
MCC6.RP.3, MCC6.RP.3a, MCC6.RP.3b

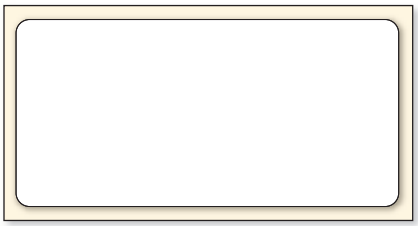
**Mathematical Practices**
1, 3, 4, 7, 8

## Real-World Link

Tools

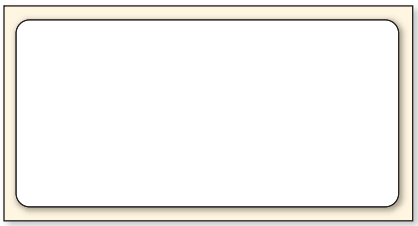
**Refreshments** A punch recipe uses one container of soda and three containers of juice to make one batch of punch.

1. Draw red counters to show the number of containers of soda and draw yellow counters to show the number of containers of juice needed to make 2 batches of punch.



soda → ☐
juice → ☐

2. Draw red counters to show the number of containers of soda and draw yellow counters to show the number of containers of juice needed to make 3 batches of punch.



soda → ☐
juice → ☐

3. Find the ratio in simplest form of soda to juice needed for 1, 2, and 3 batches. What do you notice?

_____

Work Zone

# Equivalent Ratios

The quantities in the opening activity can be organized into a table. This table is called a **ratio table** because the columns are filled with pairs of numbers that have the same ratio.

| Soda | 1 | 2 | 3 |
|---|---|---|---|
| Juice | 3 | 6 | 9 |

The ratios $\frac{1}{3}$, $\frac{2}{6}$, and $\frac{3}{9}$ are equivalent, since each simplifies to a ratio of $\frac{1}{3}$.

**Equivalent ratios** express the same relationship between quantities.

## Examples

Watch Tutor

**1.** **To make yellow icing, you mix 6 drops of yellow food coloring with 1 cup of white icing. How much yellow food coloring should you mix with 5 cups of white icing to get the same shade?**

Use a ratio table. Since $1 \times 5 = 5$, multiply each quantity by 5.

So, add 30 drops of yellow food coloring to 5 cups of icing.

| | | ×5 |
|---|---|---|
| Drops of Yellow | 6 | 30 |
| Cups of Icing | 1 | 5 |
| | ×5 | |

**2.** **In a recent year, Joey Chestnut won a hot dog eating contest by eating nearly 66 hot dogs in 12 minutes. If he ate at a constant rate, determine about how many hot dogs he ate every 2 minutes.**

Divide each quantity by one or more common factors until you reach a quantity of 2 minutes.

So, Chestnut ate about 11 hot dogs every 2 minutes.

| | ÷2 | ÷2 | ÷3 |
|---|---|---|---|
| Hot Dogs | 66 | 33 | 11 |
| Time (min) | 12 | 6 | 2 |
| | ÷2 | ÷2 | ÷3 |

**Check for Accuracy**

To check your answer for Example 2, check to see if the ratio of the two new quantities is equivalent to the ratio of the original quantities.

$\frac{11}{2} \times \frac{6}{6} = \frac{66}{12}$

**Got It?** Do these problems to find out.

Show your work.

**a.** A patient receives 1 liter of IV fluids every 8 hours. At that rate, find how many hours it will take to receive 4 liters of IV fluids.

| IV Fluids (L) | 1 | 4 |
|---|---|---|
| Time (h) | 8 | |

a. _____

**b.** To make cranberry jam, you need 12 cups of sugar for every 16 cups of cranberries. Find the amount of sugar needed for 4 cups of cranberries.

| Sugar (c) | 12 | | |
|---|---|---|---|
| Cranberries (c) | 16 | | 4 |

b. _____

# Use Scaling

Multiplying or dividing two related quantities by the same number is called **scaling**. Sometimes you may need to *scale back* and then *scale forward* to find an equivalent ratio.

## Examples

Tutor

**3.** **Cans of corn are on sale at 10 for $4. Find the cost of 15 cans.**

| Cans of Corn | 10 | | 15 |
|---|---|---|---|
| Cost in Dollars | 4 | | ■ |

There is no whole number by which you can multiply 10 to get 15. So, scale back to 5 and then scale forward to 15.

| | ÷2 | | ×3 |
|---|---|---|---|
| Cans of Corn | 10 | 5 | 15 |
| Cost in Dollars | 4 | 2 | 6 |
| | ÷2 | | ×3 |

Divide each quantity by a common factor, 2.

Then, since $5 \times 3 = 15$, multiply each quantity by 3.

So, 15 cans of corn would cost $6.

**4.** **Joe mows lawns during his summer vacation to earn money. He took 14 hours last week to mow 8 lawns. At this rate, how many lawns could he mow in 49 hours?**

Is there a whole number by which you can multiply 14 to get 49? _____

Scale back to _____, and then scale forward to _____.

| | ÷2 | | ×7 |
|---|---|---|---|
| Number of Hours | 14 | 7 | 49 |
| Number of Lawns | 8 | 4 | 28 |
| | ÷2 | | ×7 |

So, Joe can mow _____ lawns in 49 hours.

**Got It?** Do this problem to find out.

**c.** A child's height measures 105 centimeters. Estimate her height in inches.

| Height (cm) | 25 | | 105 |
|---|---|---|---|
| Height (in.) | 10 | | |

Show your work.

c. _____

## Example

**5.** **On her vacation, Leya exchanged $50 American and received $60 Canadian. Use a ratio table to find how many Canadian dollars she would receive for $20 American.**

Set up a ratio table. Use scaling to find the desired quantity.

| | ÷10 | | ×4 |
|---|---|---|---|
| **Canadian Dollars** | 60 | 6 | 24 |
| **American Dollars** | 50 | 5 | 20 |
| | ÷10 | | ×4 |

Divide each quantity by a common factor, 10.

Then, since $5 \times 4 = 20$, multiply each quantity by 4.

Leya would receive $24 Canadian for $20 American.

## Guided Practice

**Complete each ratio table to solve each problem.**

**1.** Santiago receives an allowance of $7 every week. How much total does he receive after 4 weeks? {Example 1)

| **Allowance ($)** | 7 | | | |
|---|---|---|---|---|
| **Number of Weeks** | 1 | | | 4 |

**2.** Tonya runs 8 kilometers in 60 minutes. At this rate, how long would it take her to run 2 kilometers? (Example 2)

| **Distance Run (km)** | 8 | | 2 |
|---|---|---|---|
| **Time (min)** | 60 | | |

**3.** Lamika buys 12 packs of juice boxes that are on sale and pays a total of $48. Use a ratio table to determine how much Lamika will pay to buy 8 more packs of juice boxes at the same store. (Example 5)

| **Number of Juice Boxes** | | | |
|---|---|---|---|
| **Price ($)** | | | |

**4.** **Building on the Essential Question** How can you determine if two ratios are equivalent?

### Rate Yourself!

How well do you understand ratio tables? Circle the image that applies.

Clear | Somewhat Clear | Not So Clear

For more help, go online to access a Personal Tutor.

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

# Independent Practice

Go online for Step-by-Step Solutions eHelp

**Complete each ratio table to solve each problem.**

**1** To make 5 apple pies, you need about 2 pounds of apples. How many pounds of apples do you need to make 20 apple pies? (Example 1)

| Number of Pies | 5 | | 20 |
|---|---|---|---|
| Pounds of Apples | 2 | | |

**2.** Four balls of wool will make 8 knitted caps. How many balls of wool will Malcolm need if he wants to make 6 caps? (Examples 3 and 4)

| Balls of Wool | 4 | | |
|---|---|---|---|
| Number of Caps | 8 | | 6 |

**3** Before leaving to visit Mexico, Levant traded 270 American dollars and received 3,000 Mexican pesos. When he returned from Mexico, he had 100 pesos left. How much will he receive when he exchanges these pesos for dollars? (Example 2)

| American Dollars | 270 | | |
|---|---|---|---|
| Mexican Pesos | 3,000 | | 100 |

**4.** On a bike trip across the United States, Rodney notes that he covers about 190 miles every 4 days. If he continues at this rate, use a ratio table to determine about how many miles he could bike in 6 days. (Example 5)

| Miles Biked | | | |
|---|---|---|---|
| Days | | | |

**5.** **Identify Repeated Reasoning** A punch recipe that serves 24 people calls for 4 liters of lemon-lime soda, 2 pints of sherbet, and 6 cups of ice.

**a.** Complete a ratio table to represent this situation.

| People Served | |
|---|---|
| Liters of Soda | |
| Pints of Sherbet | |
| Cups of Ice | |

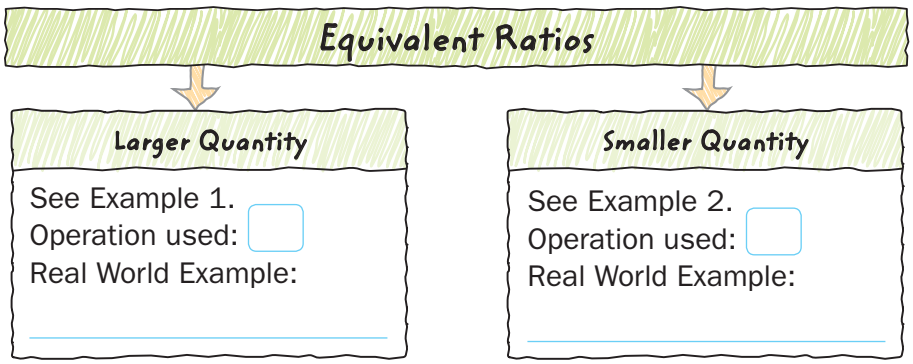
**b.** How much of each ingredient would you need to make an identical recipe that serves 12 people? 36 people?

**c.** How much of each ingredient would you need to make an identical recipe that serves 18 people? Explain your reasoning.

6. On a typical day, flights at a local airport arrive at a rate of 10 every 15 minutes. At this rate, how many flights would you expect to arrive in 1 hour?

| Number of Flights | | | |
|---|---|---|---|
| Minutes | | | |

7. **Identify Structure** Complete the graphic organizer to explain how equivalent ratios are used to find larger quantities and smaller quantities.




## H.O.T. Problems Higher Order Thinking

8. **Persevere with Problems** Use the ratio table to determine how many people 13 subs would serve. Explain.

| Number of Subs | 3 | 5 | 8 | 13 |
|---|---|---|---|---|
| People Served | 12 | 20 | 32 | |

9. **Justify Conclusions** There are 10 girls and 8 boys in Mr. Augello's class. If 5 more girls and 5 more boys join the class, will the ratio of girls to boys remain the same? Justify your answer using a ratio table.

| Girls | | | |
|---|---|---|---|
| Boys | | | |

## Georgia Test Practice

10. Leo buys 5 DVDs for $60. At this rate, how much would he pay for 3 DVDs?

Ⓐ $10
Ⓑ $30
Ⓒ $36
Ⓓ $58

Name _____ My Homework _____

# Extra Practice

**Complete each ratio table to solve each problem.**

**11.** A zoo requires that 1 adult accompany every 7 students that visit the zoo. How many adults must accompany 28 students? 4 adults

Homework Help

| Number of Adults | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Number of Students | 7 | 14 | 21 | 28 |

+1 +1 +1 +7 +7 +7

**12.** Valentina purchased 200 beads for $48 to make necklaces. If she needs to buy 25 more beads, how much will she pay if she is charged the same rate?

| Number of Beads | 200 | | 25 |
|---|---|---|---|
| Cost in Dollars | 48 | | |

**13.** If a hummingbird were to get all of its food from a feeder, then a 16-ounce nectar feeder could feed about 80 hummingbirds a day. How many hummingbirds would you expect to be able to feed with a 12-ounce feeder?

| Ounces of Nectar | 16 | | 12 |
|---|---|---|---|
| Number of Birds Fed | 80 | | |

**14.** When a photo is reduced or enlarged, its length to width ratio usually remains the same. Aurelia wants to enlarge a 4-inch by 6-inch photo so that it has a width of 15 inches. Use a ratio table to determine the new length of the photo.

| Length (in.) | 4 | | |
|---|---|---|---|
| Width (in.) | 6 | | |

**15.** Landon owns a hybrid SUV that can travel 400 miles on a 15-gallon tank of gas. Determine how many miles he can travel on 6 gallons.

**16.** CCSPS **Justify Conclusions** A veterinarian needs to know an animal's weight in kilograms. If 20 pounds is about 9 kilograms and a dog weighs 30 pounds, use a ratio table to find the dog's weight in kilograms. Explain your reasoning.

| Pounds | | | |
|---|---|---|---|
| Kilograms | | | |

## Georgia Test Practice

**17.** Jaylen is making biscuits using the recipe below.

**Whole Wheat Biscuits**

| | |
|---|---|
| 2 c | Whole wheat flour |
| 4 tsp | Baking powder |
| $\frac{1}{2}$ tsp | Salt |
| 2 tbsp | Shortening |
| 1 c | Milk |
| 1 | Small egg |

*Makes 20 biscuits*

How many cups of flour will he need to make 30 biscuits?

Ⓐ $1\frac{1}{2}$ cups
Ⓑ 3 cups
Ⓒ 10 cups
Ⓓ 15 cups

**18.** A tutor's rates are shown in the ratio table. Use the ratio table to determine how much she charges for 5 hours.

| Cost ($) | 30 | | |
|---|---|---|---|
| Number of Hours | 2 | | 5 |

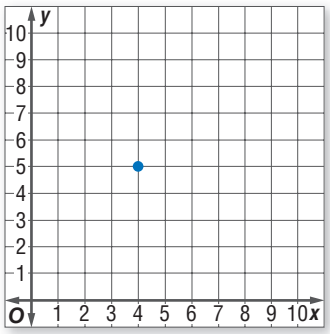
Ⓕ $15
Ⓖ $30
Ⓗ $33
Ⓘ $75

**19.** **Short Response** Beth walks 2 blocks in 15 minutes. How many blocks would Beth walk if she walked at the same rate for an hour? Explain your reasoning.

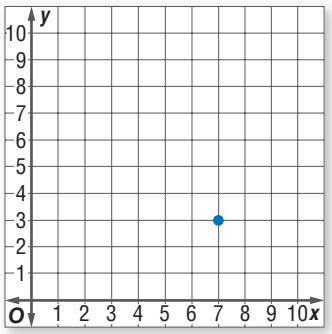
## Common Core Review

**Identify each point shown on the graph.** MCC5.G.1

**20.** (_____, _____)

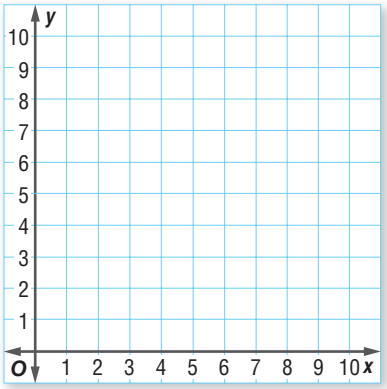



**21.** (_____, _____)




**22.** Liam is drawing a map. He needs to plot four points to identify four places on his map. Plot and label the following points. MCC5.G.2

**a.** the library at (3, 2)
**b.** the school at (6, 4)
**c.** the park at (8, 1)
**d.** Liam's house at (2, 8)



# Graph Ratio Tables

**What You'll Learn**

Scan the lesson. List two headings you would use to make an outline of the lesson.

- _____
- _____

**Essential Question**

HOW do you use equivalent rates in the real world?

**Vocabulary**

coordinate plane
origin
*x*-axis
*y*-axis
ordered pair
*x*-coordinate
*y*-coordinate
graph

**Common Core GPS**

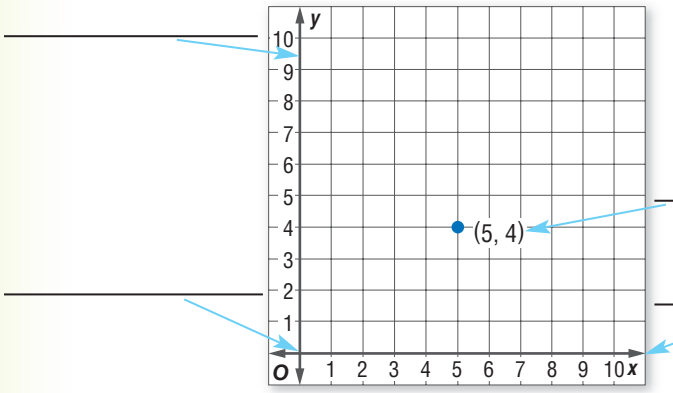
**Content Standards**
MCC6.RP.3, MCC6.RP.3a

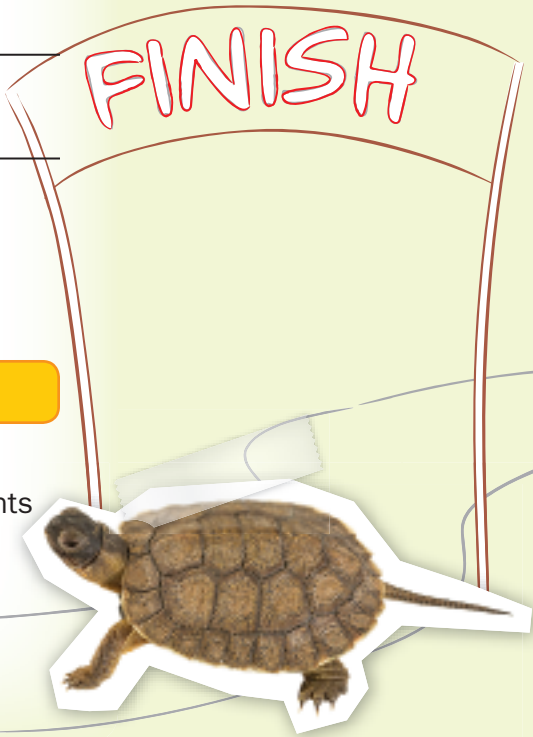
**Mathematical Practices**
1, 3, 4

## Vocabulary Start-Up

The **coordinate plane** is formed when two perpendicular number lines intersect at their zero points. This point is called the **origin**. The horizontal number line is called the ***x*-axis** and the vertical number line is called the ***y*-axis**. An **ordered pair**, such as (2, 3), is a pair of numbers used to locate a point on the coordinate plane.

**Fill in the blanks with the hightlighted words from above.**




## Real-World Link

In 3 minutes, a North American wood turtle can travel about 17 yards. If the *x*-axis represents minutes and the *y*-axis represents yards, write an ordered pair to represent this situation.

( , )
minutes yards

Work Zone

# Graph Ordered Pairs

You can use an ordered pair to name any point on the coordinate plane. The first number in an ordered pair is the **x-coordinate**, and the second number is the **y-coordinate**.

The *x*-coordinate corresponds to a number on the *x*-axis. → **(3, 6)** ← The *y*-coordinate corresponds to a number on the *y*-axis.

You can express information in a table as a set of ordered pairs. To see patterns, **graph** the ordered pairs on the coordinate plane.

## Examples

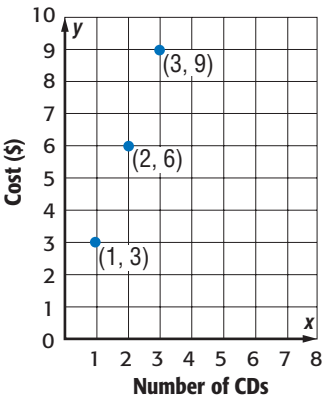
Tutor

**The table shows the cost in dollars to create CDs of digital photos at a photo shop. The table also shows this information as ordered pairs (number of CDs, cost in dollars).**

| Cost to Create CDs | | |
|---|---|---|
| Number of CDs, *x* | Cost in Dollars, *y* | Ordered Pair (*x*, *y*) |
| 1 | 3 | (1, 3) |
| 2 | 6 | (2, 6) |
| 3 | 9 | (3, 9) |

**1. Graph the ordered pairs.**

Start at the origin. Use the *x*-coordinate and move along the *x*-axis. Then use the *y*-coordinate and move along the *y*-axis. Draw a dot at each point.

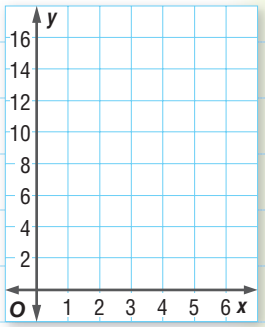



**2. Describe the pattern in the graph.**

The points appear in a line. Each point is one unit to the right and three units up from the previous point.

So, the cost increases by $3 for every CD created.

Show your work.

a. 


b. _____

**Got It?** Do these problems to find out.

**The table shows Gloria's earnings for 1, 2, and 3 hours. The table also lists this information as ordered pairs (hours, earnings).**

| Gloria's Earnings | | |
|---|---|---|
| Hours, *x* | Dollars Earned, *y* | Ordered Pair (*x*, *y*) |
| 1 | 5 | (1, 5) |
| 2 | 10 | (2, 10) |
| 3 | 15 | (3, 15) |

**a.** Graph the ordered pairs.

**b.** Describe the pattern in the graph.

# Compare Ratios

You can use tables and graphs to compare ratios. The greater the ratio, the steeper the line will appear.

## Examples

Tutor

**Two friends are making scrapbooks. Renée places 4 photos on each page of her scrapbook. Gina places 6 photos on each page of her scrapbook.**

**3. Make a table for each scrapbook that shows the total number of photos placed, if each book has 1, 2, 3, or 4 pages. List the information as ordered pairs (pages, photos).**

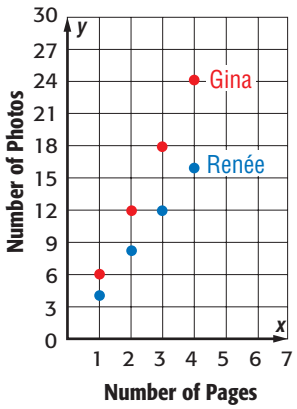
| Renée's Scrapbook | | |
|---|---|---|
| Pages, $x$ | Photos, $y$ | $(x, y)$ |
| 1 | 4 | (1, 4) |
| 2 | 8 | (2, 8) |
| 3 | 12 | (3, 12) |
| 4 | 16 | (4, 16) |

| Gina's Scrapbook | | |
|---|---|---|
| Pages, $x$ | Photos, $y$ | $(x, y)$ |
| 1 | 6 | (1, 6) |
| 2 | 12 | (2, 12) |
| 3 | 18 | (3, 18) |
| 4 | 24 | (4, 24) |

**4. Graph the ordered pairs for each friend on the same coordinate plane.**

Graph the ordered pairs for Renée's scrapbook in blue.

Graph the ordered pairs for Gina's scrapbook in red.




**5. How does the ratio of photos to each page compare for each person? How is this shown on the graph?**

The ratio of photos to pages for Renée's scrapbook is 4:1 while the ratio for Gina's scrapbook is 6:1. On the graph, both sets of points appear to be in a straight line, but the line for Gina is steeper than the line for Renée.

**STOP and Reflect**

Marta is also making a scrapbook. She places 5 photos on each page. How does the ratio of photos to each page compare for her book, Gina's book, and Renée's book?

## Guided Practice

**Two friends are each saving money in their bank accounts. Marcus saves $10 each week while David saves $15 each week.** (Examples 1–5)

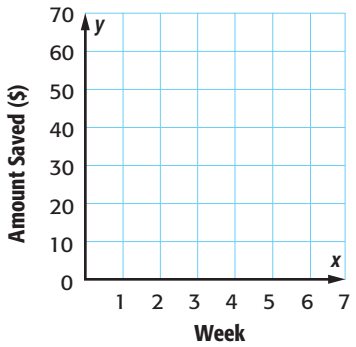
**1.** Make a table for each friend that shows the total amount saved for 1, 2, 3, or 4 weeks. List the information as ordered pairs (weeks,total dollars saved).

Show your work.

| Marcus | | |
|---|---|---|
| Weeks, $x$ | Total Saved ($), $y$ | $(x, y)$ |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

| David | | |
|---|---|---|
| Weeks, $x$ | Total Saved ($), $y$ | $(x, y)$ |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

**2.** Graph the ordered pairs for each friend on the same coordinate plane.




**3.** How do the ratios of Marcus's savings and David's savings compare? How is this shown on the graph?

**4.** **Building on the Essential Question** How can graphing help solve a problem involving ratios?

### Rate Yourself!

How confident are you about graphing ratios? Check the box that applies.

For more help, go online to access a Personal Tutor.

Tutor

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

# Independent Practice

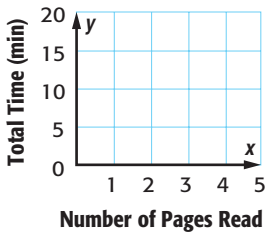
Go online for Step-by-Step Solutions eHelp

**The table shows the total time it took Samir to read 0, 1, 2, and 3 pages of the book. The table also lists this information as ordered pairs (number of pages, total minutes).** (Examples 1–2)

| Samir's Reading | | |
|---|---|---|
| Number of Pages, $x$ | Total Minutes, $y$ | Ordered Pair $(x, y)$ |
| 0 | 0 | (0, 0) |
| 1 | 4 | (1, 4) |
| 2 | 8 | (2, 8) |
| 3 | 12 | (3, 12) |

**1** Graph the ordered pairs.

Show your work.




**2.** Describe the pattern in the graph.

_____

_____

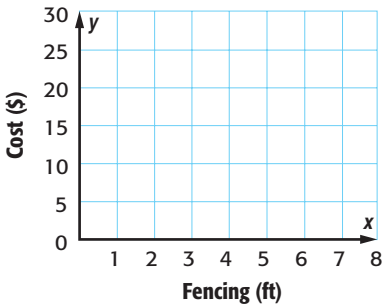
**Ken's Home Supply charges $5 for each foot of fencing. Wayne's Warehouse charges $6 for each foot of fencing.** (Examples 3–5)

**3.** Make a table for each store that shows the total cost for 1, 2, 3, or 4 feet of fencing. List the information as ordered pairs (feet of fencing, total cost).

| Ken's Home Supply | | |
|---|---|---|
| Fencing (ft), $x$ | Cost ($), $y$ | $(x, y)$ |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

| Wayne's Warehouse | | |
|---|---|---|
| Fencing (ft), $x$ | Cost ($), $y$ | $(x, y)$ |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

**4.** Graph the ordered pairs for each store on the same coordinate plane.




**5** Using the tables and graphs, write a few sentences comparing the ratios of amount charged per foot of fencing for each store. How is this shown on the graph?

_____

_____

_____

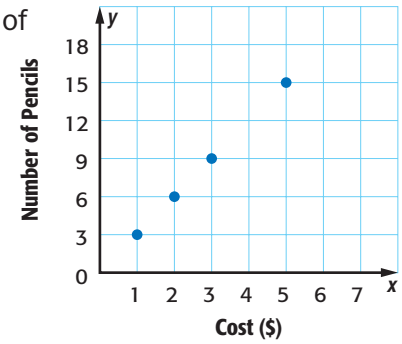
6. **Justify Conclusions** Patty's Pies made 2 peach pies using 10 cups of peaches. They made 3 pies using 15 cups of peaches and 4 pies using 20 cups of peaches. Predict how many cups of peaches would be needed to make 9 peach pies. Explain.

## H.O.T. Problems Higher Order Thinking

7. **Model with Mathematics** Write a real-world problem using ratios that could be represented on the coordinate plane.

8. **Persevere with Problems** Give the coordinates of the point located halfway between (2, 1) and (2, 4).

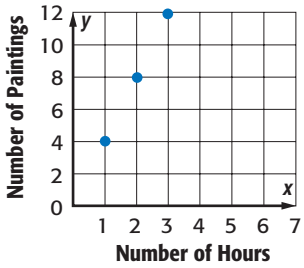
9. **Persevere with Problems** The graph below shows the cost of purchasing pencils from the school office. The graph is missing a point to indicate the cost of 12 pencils. Complete the graph by plotting the missing information. Explain your answer.



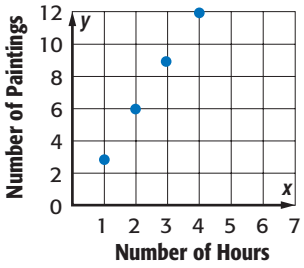

## Georgia Test Practice

10. It takes an artist one hour to frame three paintings. Which graph represents this?

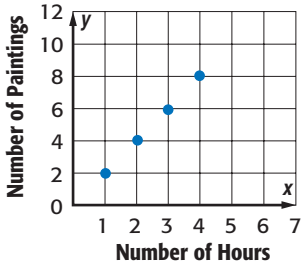
Ⓐ



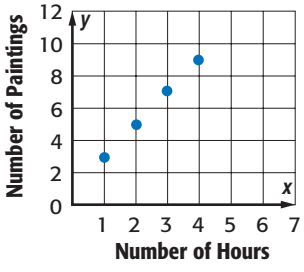

Ⓒ




Ⓑ




Ⓓ



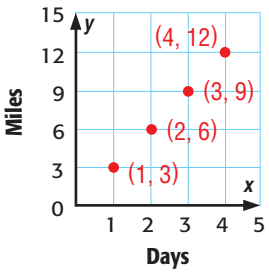
Name _____ My Homework _____

# Extra Practice

**The table shows the total number of miles Ariel runs for several days. The table also lists this information as ordered pairs (number of days, total miles).**

**11.** Graph the ordered pairs.

Homework Help




| Ariel's Running Record | | |
|---|---|---|
| **Days, *x*** | **Miles, *y*** | **(*x*, *y*)** |
| 1 | 3 | (1, 3) |
| 2 | 6 | (2, 6) |
| 3 | 9 | (3, 9) |
| 4 | 12 | (4, 12) |

**12.** Describe the pattern in the graph. The graph shows that as the number of days increases by 1, the number of miles ran increases by 3.

**There are two employees for every tiger in the tiger exhibit at a local zoo. For every elephant in the elephant exhibit, there are four employees.**

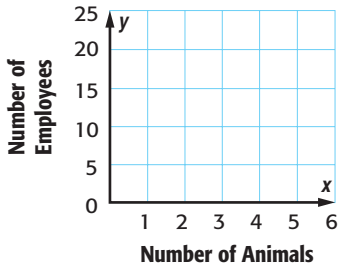
**13.** Make a table for each animal that shows the total number of employees for 1, 2, 3, or 4 animals. List the information as ordered pairs (number of animals, number of employees).

| Tiger Exhibit | | |
|---|---|---|
| **Animals, *x*** | **Employees, *y*** | **(*x*, *y*)** |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

| Elephant Exhibit | | |
|---|---|---|
| **Animals, *x*** | **Employees, *y*** | **(*x*, *y*)** |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

**14.** Graph the ordered pairs for each store on the same coordinate plane.

**15.** **Justify Conclusions** Using the tables and graphs, write a few sentences comparing the ratios of the number of employees per animal. How is this shown on the graph?



## Georgia Test Practice

**16.** The table gives the ratio of teachers to students at Jefferson Middle School.

At Hamilton Middle School, the ratio of teachers to students is 26 to 1. Which statement correctly compares the ratio of teachers to students at the two schools?

| Jefferson Middle School | |
|---|---|
| Students, $x$ | Teachers, $y$ |
| 24 | 1 |
| 48 | 2 |
| 72 | 3 |
| 96 | 4 |

Ⓐ There are more students per teacher at Hamilton Middle School than at Jefferson Middle School.

Ⓑ Both schools have an equivalent ratio of students to teachers.

Ⓒ There are more students at Hamilton Middle School than at Jefferson Middle School.

Ⓓ There are more students per teacher at Jefferson Middle School than at Hamilton Middle School.

**17.** **Short Response** Nina earns $15 for each yard she mows. The table shows her earnings for 0, 1, 2, and 3 yards mowed. How much will Nina earn if she mows 6 yards?

_____

| Nina's Earnings | |
|---|---|
| Yards Mowed | Dollars Earned ($) |
| 0 | 0 |
| 1 | 15 |
| 2 | 30 |
| 3 | 45 |

## Common Core Review

**Simplify each fraction.** MCC5.NF.5b

**18.** $\frac{13}{78} = \frac{\square}{\square}$

**19.** $\frac{26}{130} = \frac{\square}{\square}$

**20.** $\frac{20}{240} = \frac{\square}{\square}$

**21.** There are 270 sixth grade students and 45 chaperones going on a field trip. How many students will be with each chaperone if the groups are divided equally? MCC5.NBT.5 _____

**22.** Several students were surveyed about their favorite class. The results are shown in the table. What fraction of the students chose music as their favorite subject? Write the fraction in simplest form. MCC5.NF.3

_____

| Favorite Class | |
|---|---|
| Art | 26 |
| English | 19 |
| Math | 21 |
| Music | 16 |
| Science | 32 |

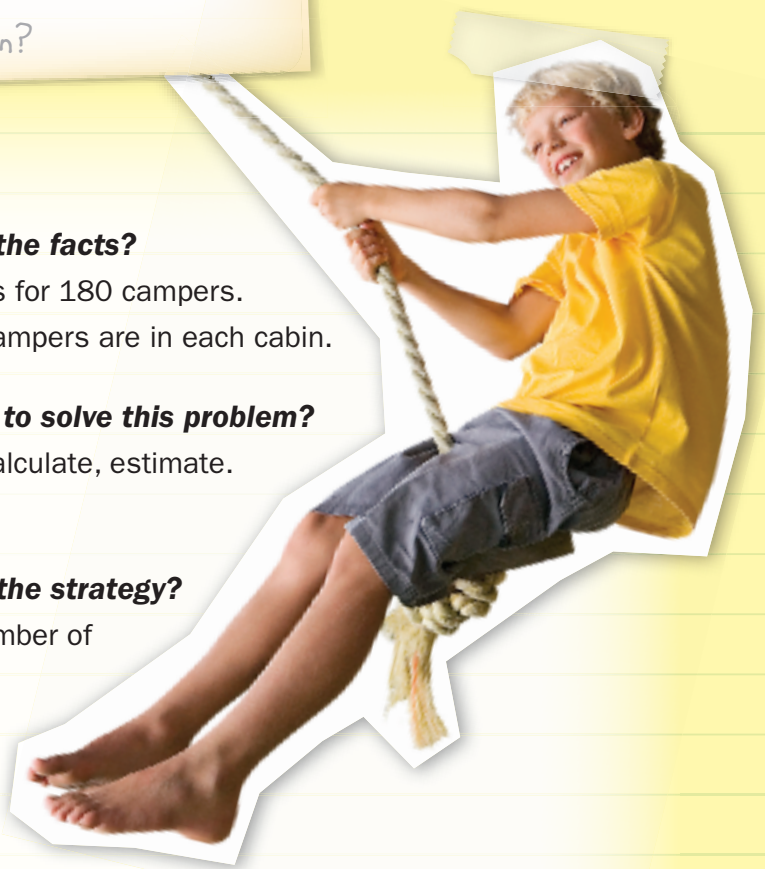
# The Four-Step Plan

**Content Standards**
MCC6.RP.3
**Mathematical Practices**
1, 3, 4

## Case #1 Cabin Fever

At a summer camp, the ratio of cabins to campers is 15 to 180. An equal number of campers are staying in each cabin.

*How many campers are in each cabin?*



### 1 Understand *What are the facts?*

- You know there are 15 cabins for 180 campers.
- You need to find how many campers are in each cabin.

### 2 Plan *What is your strategy to solve this problem?*

Divide 180 by 15. Before you calculate, estimate.

Estimate $200 \div 20 =$ ☐

### 3 Solve *How can you apply the strategy?*

Use long division to find the number of campers in each cabin.

$$\begin{array}{r} \square \\ 15\overline{)180} \\ -\square \\ \hline 30 \\ -30 \\ \hline 0 \end{array}$$

There are ☐ campers in each cabin.

### 4 Check *Does the answer make sense?*

Check by multiplying. Since $12 \times 15 =$ ☐, the answer is correct.

## Analyze the Strategy

Tutor

**Justify Conclusions** How many campers would be in each cabin if the ratio of cabins to campers was 15 to 225? Explain.

## Case #2 Show Me the Money

The table shows Kaylee's weekly allowance.

| Age | 10 | 11 | 12 | 13 |
|---|---|---|---|---|
| Weekly Allowance ($) | 2 | 4 | 6 | ■ |

If the pattern continues, how much allowance will Kaylee earn when she is 13 years old?

## 1 Understand

**Read the problem. What are you being asked to find?**

I need to find _____

**Underline key words and values in the problem. What information do you know?**

The top row shows an increase of ☐ year. The bottom row shows an increase of $☐ per year.

## 2 Plan

**Choose an operation.**

I will use _____ to solve this problem.

## 3 Solve

**Describe the pattern in the table. Then complete it using your problem-solving strategy.**

_____

| Age | 10 | 11 | 12 | 13 |
|---|---|---|---|---|
| Weekly Allowance ($) | 2 | 4 | 6 | |

+1 +1 +1

+2 +2 ☐

6 + ☐ = ☐ So, Kaylee will earn $☐ when she is 13 years old.

## 4 Check

**Use information from the problem to check your answer.**

Use subtraction to check your answer. ☐ – ☐ = 6

**Collaborate** Work with a small group to solve the following cases. Show your work on a separate piece of paper.

## Case #3 Walking

Megan uses a pedometer to find how many steps she takes each school day. She took 32,410 steps over the course of 5 days.

If she took the same number of steps each day, how many did she take on Monday?

## Case #4 Pools

The table shows the total amount of water in a swimming pool that is being filled.

| Time (min) | 5 | 10 | 15 | 20 |
|---|---|---|---|---|
| Water (gal) | 75 | 150 | 225 | 300 |

At this rate, how much water will be in the swimming pool after 30 minutes?

## Case #5 Money

Mrs. Eddington is buying a new big-screen television. She made an initial payment of $50 and will pay $70 per month for 12 months.

How much will she spend in all for the television?

Circle a strategy below to solve the problem.

- Look for a pattern.
- Solve a simpler problem.
- Act it out.
- Make a list.

## Case #6 Sports Equipment

Mrs. Dimas has $130 to buy basketballs for Edison Middle School.

How many can she buy at $15 each? Interpret the remainder.

# Mid-Chapter Check

## Vocabulary Check

1. Fill in the blank in the sentence below with the correct term. (Lesson 1)

   A _____ is a comparison of two quantities by division.

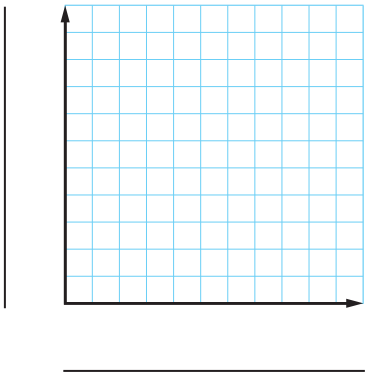
## Skills Check and Problem Solving

2. Write *15 cookies to 40 brownies* as a ratio in simplest form. (Lesson 1) _____

3. Write 171 miles in 3 hours as a unit rate. (Lesson 2) _____

4. **Use Math Tools** The table below shows the amount in Josiah's account each week. List the information as ordered pairs and then graph the ordered pairs. Describe the pattern in the graph. (Lesson 4)

| Josiah's Savings | | |
|---|---|---|
| **Week, *x*** | **Savings ($), *y*** | **Ordered Pair (*x*, *y*)** |
| 1 | 5 | |
| 2 | 10 | |
| 3 | 15 | |
| 4 | 20 | |
| 5 | 25 | |



5. **Georgia Test Practice** The ratio of brown tiles to tan tiles is 2 to 3. If an artist needs 16 brown tiles to complete a mosaic, how many tan tiles will the artist need? (Lesson 3)

   Ⓐ 8 Ⓒ 17

   Ⓑ 16 Ⓓ 24

# Equivalent Ratios

**What You'll Learn**

Scan the lesson. List two things you will learn about equivalent ratios.

- _____
- _____

**Essential Question**

HOW do you use equivalent rates in the real world?

**Common Core GPS**

**Content Standards**
MCC6.RP.3, MCC6.RP.3b

**Mathematical Practices**
1, 3, 4, 6, 7

## Real-World Link

**Photography** Andrea spent $2 to make 10 prints from a photo booth. Later, she spent $6 to make 30 prints.

| Number of Prints | Cost ($) |
|---|---|
| 10 | 2 |
| 30 | 6 |

1. Express the relationship between the number of prints she made and the total cost for each situation as a rate in fraction form.

   $\frac{\square}{\square}$ prints and $\frac{\square}{\square}$ prints

2. Compare the relationship between the numerators of each rate in Exercise 1. Compare the relationship between the denominators of these rates.

   _____

   _____

   _____

3. What is the unit rate for 10 prints? _____

4. What is the unit rate for 30 prints? _____

5. Are the rates in Exercise 1 equivalent? Explain.

   _____

   _____

Work Zone

# Use Unit Rates

There are different ways to determine if two ratios or rates are equivalent. One way is by examining unit rates. By comparing quantities as rates in simplest form, you can determine if the relationship between the two quantities stays the same.

$$\frac{10 \text{ prints}}{\$2} \overset{\div 2}{=} \frac{5 \text{ prints}}{\$1} \quad \text{and} \quad \frac{30 \text{ prints}}{\$6} \overset{\div 6}{=} \frac{5 \text{ prints}}{\$1}$$

Since the rates have the same unit rate, they are equivalent ratios.

## Examples

Tutor

**Determine if each pair of rates is equivalent. Explain your reasoning.**

**1.** **20 miles in 5 hours; 45 miles in 9 hours**

Write each rate as a fraction. Then find its unit rate.

$$\frac{20 \text{ miles}}{5 \text{ hours}} \overset{\div 5}{=} \frac{4 \text{ miles}}{1 \text{ hour}} \qquad \frac{45 \text{ miles}}{9 \text{ hours}} \overset{\div 9}{=} \frac{5 \text{ miles}}{1 \text{ hour}}$$

Since the rates do not have the same unit rate, they are not equivalent.

**Unit Rates**

The unit rate in Example 2, $\frac{\$7}{1 \text{ T-shirt}}$, is called the unit price since it gives the cost per unit.

**2.** **3 T-shirts for $21; 5 T-shirts for $35**

$$\frac{\$21}{3 \text{ T-shirts}} \overset{\div 3}{=} \frac{\$7}{1 \text{ T-shirt}} \qquad \frac{\$35}{5 \text{ T-shirts}} \overset{\div 5}{=} \frac{\$7}{1 \text{ T-shirt}}$$

Since the rates have the same unit rate, they are equivalent.

**Got It?** Do these problems to find out.

**Determine if each pair of rates is equivalent. Explain your reasoning.**

a. _____

Show your work.

b. _____

**a.** 36 T-shirts in 3 boxes; 60 T-shirts in 6 boxes

**b.** 42 flowers in 7 vases; 54 flowers in 9 vases

## Example

Tutor

**3.** **Felisa read the first 60 pages of a book in 3 days. She read the last 90 pages in 6 days. Are these reading rates equivalent? Explain your reasoning.**

$$\frac{60 \text{ pages}}{3 \text{ days}} \overset{\div 3}{=} \frac{20 \text{ pages}}{1 \text{ day}} \qquad \frac{90 \text{ pages}}{6 \text{ days}} \overset{\div 6}{=} \frac{15 \text{ pages}}{1 \text{ day}}$$

Since the rates do not have the same unit rate, they are not equivalent. So, Felisa's reading rates are not equivalent.

**Got It?** **Do these problems to find out.**

**c.** Marcia made 10 bracelets for 5 friends. Jen made 12 bracelets for 4 friends. Are these rates equivalent? Explain your reasoning.

**d.** Club A raised $168 by washing 42 cars. Club B raised $152 by washing 38 cars. Are these fundraising rates equivalent? Explain your reasoning.

**Proportion**
A proportion is an equation stating that two ratios or rates are equivalent.

c. _____

Show your work.

d. _____

# Use Equivalent Fractions

If a unit rate is not easily found, use equivalent fractions to decide whether the ratios or rates are equivalent.

## Examples

Tutor

**Determine if the pair of ratios or rates is equivalent. Explain your reasoning.**

**4.** **3 free throws made out of 7 attempts;**
**9 free throws made out of 14 attempts**

Write each ratio as a fraction.

$$\frac{3 \text{ free throws}}{7 \text{ attempts}} \overset{?}{=} \frac{9 \text{ free throws}}{14 \text{ attempts}} \qquad (\times 3 \text{ above}, \times 2 \text{ below})$$

The numerator and the denominator are not multiplied by the same number. So, the fractions are not equivalent.

Since the fractions are *not* equivalent, the ratios are not equivalent.

**5.** **Selena is comparing the cost of two packages of DVDs. A package of 6 DVDs costs $90 and a package of 3 DVDs costs $45. Are the rates equivalent? Explain your reasoning.**

$$\frac{6 \text{ DVDs}}{\$90} \overset{\div 2}{=} \frac{3 \text{ DVDs}}{\$45}$$

The numerator and the denominator are divided by the same number. So, the fractions are equivalent.

Since the fractions are equivalent, the ratios are equivalent.

**Got It?** **Do this problem to find out.**

Show your work.

**e.** Mrs. Jeffries has 12 girls out of 16 students on the Student Council. The Earth Day Committee has 4 girls out of 8 students. Are the ratios equivalent? Explain your reasoning.

e. _____

## Guided Practice

Check

**Determine if each pair of ratios or rates is equivalent. Explain your reasoning.**

**1.** $24 saved after 3 weeks; $52 saved after 7 weeks (Examples 1 and 2)

Show your work.

**2.** 270 Calories in 3 servings; 450 Calories in 5 servings (Examples 1 and 2)

**3.** Micah can do 75 push-ups in 3 minutes. Eduardo can do 130 push-ups in 5 minutes. Are these rates equivalent?

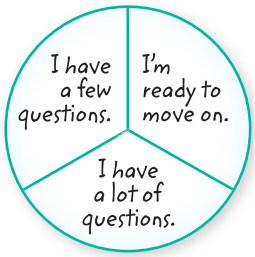
Explain. (Example 3)

**4.** A human adult takes about 16 breaths in 60 seconds. A puppy takes about 8 breaths in 15 seconds. Are these rates equivalent? Explain your reasoning. (Examples 4 and 5)

**5.** **Building on the Essential Question** How can you determine if two ratios are equivalent?

### Rate Yourself!

Are you ready to move on? Shade the section that applies.

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Tutor

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

# Independent Practice

Go online for Step-by-Step Solutions eHelp

**Determine if each pair of ratios or rates is equivalent. Explain your reasoning.** (Examples 1–2, 4–5)

**1** $3 for 6 bagels; $9 for 24 bagels

**2.** $12 for 3 paperback books; $28 for 7 paperback books

**3** 3 hours worked for $12; 9 hours worked for $36

**4.** 12 minutes to drive 30 laps; 48 minutes to drive 120 laps

**5.** Jenny is comparing the cost of two packages of socks. One package has 8 pairs of socks for $12. Another package has 3 pairs of socks for $6. Are the rates equivalent? Explain your reasoning.

**6.** Jade enlarged the photograph at the right to a poster. The size of the poster is 60 inches by 100 inches. Is the ratio of the poster's length and width equivalent to the ratio of the photograph's length and width? Explain your reasoning. (Example 3)


**7** CCSPS **Justify Conclusions** On a math test, it took Kiera 30 minutes to do 6 problems. Heath finished 18 problems in 40 minutes. Did the students work at the same rate? Explain your reasoning.

8. **Be Precise** Refer to the graphic novel frame below for Exercises a–b.


**a.** What is the unit price for the cans of lemonade at each of the stores?

**b.** From which store should Mei, Pilar, and David purchase the cans of lemonade? Explain.

## H.O.T. Problems Higher Order Thinking

9. **Persevere with Problems** To verify equivalent ratios, you can use cross products. If the cross products are equal, the ratios are equivalent.

$\frac{2}{3} \overset{12}{\times} \frac{4}{6}$ Since $12 = 12$, the ratios are equivalent.

Determine whether each pair of ratios are equivalent. Explain.

**a.** $\frac{3}{5}, \frac{9}{15}$

**b.** $\frac{2}{7}, \frac{5}{21}$

10. **Identify Structure** Write two ratios that are equivalent to $\frac{5}{7}$.

## Georgia Test Practice

11. The ratio of girls to boys in the junior high band is 3 to 4. Which of these shows possible numbers of the girls and boys in the band?

Ⓐ 30 girls, 44 boys
Ⓑ 27 girls, 36 boys
Ⓒ 22 girls, 28 boys
Ⓓ 36 girls, 50 boys

Name _____ My Homework _____

# Extra Practice

**Determine if each pair of ratios or rates is equivalent. Explain your reasoning.**

**12.** 16 points scored in 4 games; 48 points scored in 8 games

Homework Help

No; $\frac{16 \text{ points}}{4 \text{ games}} = \frac{4 \text{ points}}{1 \text{ game}}$ and $\frac{48 \text{ points}}{8 \text{ games}} = \frac{6 \text{ points}}{1 \text{ game}}$; Since the unit rates are not the same, the rates are not equivalent.

**13.** 96 words typed in 3 minutes; 160 words typed in 5 minutes

**14.** 15 computers for 45 students; 45 computers for 135 students

**15.** 16 out of 28 students own pets; 240 out of 560 students own pets

**16.** 288 miles on 12 gallons of fuel; 240 miles on 10 gallons of fuel

**17.** Fenton is building a model of a living room. The model sofa is 16 inches long and 7 inches deep. The real sofa's dimensions are 80 inches long and 35 inches deep. Is the ratio of the model's dimensions equivalent to the ratio of the real sofa's dimensions? Explain your reasoning.

**18.** Store A sells 12 juice bottles for $4 and store B sells 18 juice bottles for $6. Are the rates equivalent? Explain your reasoning.

**19.** **Justify Conclusions** Rosalinda saved $35 in 5 weeks. Her sister saved $56 in 56 days. Are the rates at which each sister saved equivalent? Explain your reasoning.

## Georgia Test Practice

**20.** The ratio of dogs to cats at a pet store is 2 to 3. Which of these shows the possible numbers of dogs and cats in the pet store?

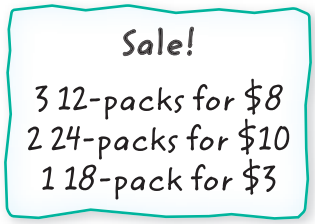
Ⓐ 12 dogs, 13 cats

Ⓑ 14 dogs, 21 cats

Ⓒ 5 dogs, 10 cats

Ⓓ 20 dogs, 23 cats

**21.** What is the cost of 8 twelve-packs of soda?



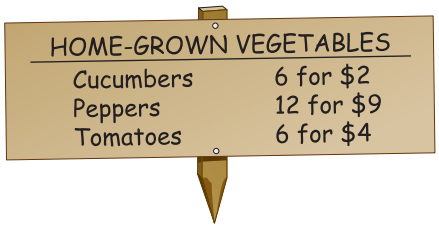

Ⓕ $64

Ⓖ $40

Ⓗ $21.33

Ⓘ $2.67

**22. Short Response** What is the cost of 15 tomatoes? _____




## Common Core Review

**Write an equivalent fraction.** MCC5.NF.5b

**23.** $\frac{11}{50} = \frac{33}{\square}$

**24.** $\frac{4}{5} = \frac{\square}{80}$

**25.** $\frac{2}{9} = \frac{28}{\square}$

**26.** Socks are on sale 4 pairs for $5. How much would you pay for 8 pairs of socks? MCC5.NBT.7

_____

**27.** Sasha bought 3 pens. Malachi bought 1 pen. How much more did Sasha spend than Malachi? MCC4.OA.3

_____

# Inquiry Lab
## Ratio and Rate Problems

**Inquiry** **HOW can you use unit rates and multiplication to solve for missing measures in equivalent ratio problems?**

**Content Standards**
MCC6.RP.3, MCC6.RP.3b

**Mathematical Practices**
1, 3, 4, 5, 8

**Racing** Jill and Sammy are racing go-karts. Jill completed 6 laps in 12 minutes. If Sammy raced at the same rate, how many minutes did it take her to complete 3 laps?

What do you know? _____

_____

What do you need to find? _____

_____

## Investigation 1

**Step 1** Use a bar diagram to represent the number of laps Jill completed. The time to travel 6 laps is 12 minutes.

Jill's race

| 12 min | | | | | |
|---|---|---|---|---|---|
| 1 lap | 1 lap | 1 lap | 1 lap | 1 lap | 1 lap |

**Step 2** Each section represents 1 lap. Determine the number of minutes it took Jill to complete one lap.

Jill completed each lap in 12 ÷ 6, or ☐ minutes.

**Step 3** Determine the number of minutes it took Sammy to complete 3 laps.

Jill's race

| 12 min | | | | | |
|---|---|---|---|---|---|
| 1 lap | 1 lap | 1 lap | 1 lap | 1 lap | 1 lap |

Sammy's race

| ? min | | |
|---|---|---|
| 1 lap | 1 lap | 1 lap |

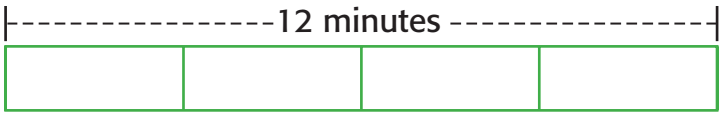
Each lap was completed in ☐ minutes.

So, Sammy's time was 3 × ☐, or ☐ minutes.

## Investigation 2

Lizette and Miguel are decorating cookies for a bake sale. Lizette can decorate 4 cookies in 12 minutes. If Miguel can decorate cookies at the same rate, how many minutes will it take him to decorate 24 cookies?

**Step 1** Use a bar diagram to represent the amount of time Lizette spent decorating cookies.




☐ minutes

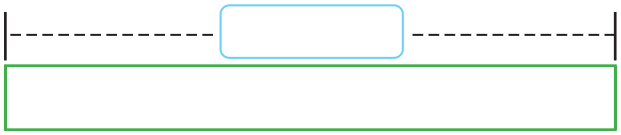
**Step 2** Label each section "1 cookie." Lizette decorated one cookie in 12 ÷ 4, or ☐ minutes.

So, it will take Miguel 24 × ☐, or ☐ minutes.

## Investigation 3

Devon drives 171 miles in 3 hours. At this rate, how many miles can he drive in 7 hours?

**Step 1** Use a bar diagram to represent the number of miles Devon drove.



☐ miles

**Step 2** Label each section "1 hour." In one hour, Devon drove 171 ÷ 3, or ☐ miles.

So, Devon will drive 7 × ☐, or ☐ miles in 7 hours.

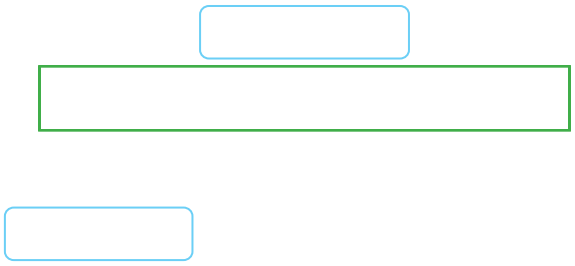
## Collaborate

**Work with a partner. Use a bar diagram to help solve each problem.**

**1.** the miles traveled in 5 hours at a rate of 189 miles in 3 hours _____

Show your work.

**2.** the number of ice cubes in 32 glasses at a rate of 20 ice cubes in 5 glasses _____



**3.** the cost of 5 pounds of bananas if 2 pounds cost $1.16 _____

**4.** the time needed to deliver 72 papers at a rate of 9 papers in 18 minutes _____

**5.** the number of squares in 15 quilts if 6 quilts have 288 squares _____

**6.** the time to run 26 miles at a rate of 12 miles in 60 minutes _____

**7.** the beads in 7 bracelets if 4 bracelets have 96 beads _____

**8.** the lemons needed for 6 pitchers of lemonade if 2 pitchers use 28 lemons _____

## Analyze

**Work with a partner to complete the table, using the recipe for trail mix. The first one is done for you.**

| | Cups of Peanuts | Cups of Raisins | Cups of Chocolate Chips | Cups of Granola |
|---|---|---|---|---|
| | 6 | 4 | 2 | 8 |
| 9. | 9 | | | |
| 10. | 12 | | | |
| 11. | 15 | | | |
| 12. | 18 | | | |
| 13. | 21 | | | |
| 14. | 24 | | | |
| 15. | 27 | | | |


16. **Identify Repeated Reasoning** Explain how you can use the information on the recipe card to solve for missing measures in the table.

## Reflect

17. **Model with Mathematics** Lee can read 1,100 words in 5 minutes. Write and solve a word problem that uses this information.

18. HOW can you use unit rates and multiplication to solve for missing measures in equivalent ratio problems?

# Ratio and Rate Problems

**What You'll Learn**

Scan the lesson. List two headings you would use to make an outline of the lesson.

- _____
- _____

**Essential Question**

HOW do you use equivalent rates in the real world?

**Common Core GPS**

**Content Standards**
MCC6.RP.3, MCC6.RP.3b

**Mathematical Practices**
1, 3, 4, 5, 7

## Real-World Link

**Games** An arcade sells game tokens individually or in packages. They are having a sale on token packages, as shown below.

| Number of Packages | Price ($) |
|---|---|
| 1 | 5 |
| 2 | 10 |
| 3 | 15 |


1. How many token packages can you buy with $20? ☐ $25? ☐ Explain.

2. What is the unit price?

3. How much would it cost to buy 6 token packages?

4. The arcade sells individual tokens for $0.25 each. If a token package contains 25 tokens, how much would you save by buying a package of 25 tokens instead of 25 individual tokens? Explain.

Work Zone

# Solve Ratio Problems

You can use bar diagrams or equations with equivalent ratios to solve ratio and rate problems.

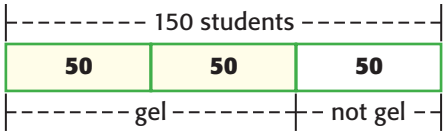
## Examples

Tutor

**1.** **Heritage Middle School has 150 students. Two out of three students in Mrs. Mason's class prefer gel toothpaste. Use this ratio to predict how many students in the entire middle school prefer gel toothpaste.**

**Method 1** **Use a bar diagram.**

**Step 1** Draw a bar diagram.




**Step 2** Determine how many students are in each section.

**Method 2** **Use equivalent fractions.**

Write an equivalent ratio.

$$\underset{\text{total}}{\overset{\text{likes gel}}{\frac{2}{3}}} = \underset{\text{total}}{\overset{\text{likes gel}}{\frac{\blacksquare}{150}}}$$

$$\frac{2}{3} \overset{\times 50}{=} \frac{100}{150}$$

Since $3 \times 50 = 150$, multiply 2 by 50.

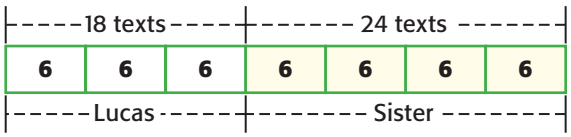
So, 100 students would prefer gel toothpaste.

**2.** **The ratio of the number of text messages sent by Lucas to the number of text messages sent by his sister is 3 to 4. Lucas sent 18 text messages. How many text messages did his sister send?**

**Method 1** **Use a bar diagram.**

**Step 1** Draw a bar diagram.

**Step 2** Determine how many text messages are in each section.




**Equivalent Ratios**

Notice that the numerators of both fractions in Method 2 refer to the number of students who like gel toothpaste. The denominators of both fractions refer to the total number of students being referenced.

**Method 2** **Use equivalent fractions.**

Write an equivalent ratio.

Lucas → $\frac{3}{4} = \frac{18}{\blacksquare}$ ← Lucas
his sister → his sister

$\frac{3}{4} \overset{\times 6}{=} \frac{18}{24}$ Since $6 \times 3 = 18$, multiply 4 by 6.

So, Lucas' sister sent 24 text messages.

**STOP and Reflect**

What is the relationship between ratios and fractions?

**Got It?** **Do these problems to find out.**

**a.** In a survey, four out of five people preferred creamy over chunky peanut butter. There are 120 people shopping at the grocery store. Use the survey to predict how many people in the store would prefer creamy peanut butter.

**b.** A survey found that 12 out of every 15 people in the United States prefer eating at a restaurant over cooking at home. If 400 people selected eating at a restaurant on the survey, how many people took the survey?

Show your work.

a. _____

b. _____

## Solve Rate Problems

You can use double number lines or equations to solve rate problems.

Real World

### Example

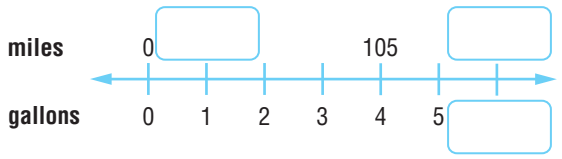
Tutor

**3.** **The Millers drove 105 miles on 4 gallons of gas. At this rate, how many miles can they drive on 6 gallons of gas?**

Draw a double number line.

$105 \div 4 = 26.25$ Find the unit rate.

$26.25 \times 6 = 157.5$ Multiply.




So, the Millers can drive 157.5 miles on 6 gallons of gas.

**Got It?** **Do this problem to find out.**

**c.** There are 810 Calories in 3 scoops of vanilla ice cream. How many Calories are there in 7 scoops of ice cream?

c. _____

## Example

**4.** **Jeremy drove his motorcycle 120 miles in 3 hours. At this rate, how many miles can he drive in 5 hours? At what rate did he drive his motorcycle?**

$$\frac{120 \text{ miles}}{3 \text{ hours}} = \frac{\blacksquare \text{ miles}}{1 \text{ hour}} \quad (\div 3) \qquad \frac{120 \text{ miles}}{3 \text{ hours}} = \frac{40 \text{ miles}}{1 \text{ hour}}$$ Find the unit rate.

$$\frac{40}{1 \text{ hour}} \times 5 \text{ hours} = 200 \text{ miles}$$ Multiply.

So, Jeremy can drive 200 miles in 5 hours driving at a rate of 40 miles per hour.

**Got It?** **Do this problem to find out.**

**d.** STEM While resting, a human takes in about 5 liters of air in 30 seconds. At this rate, how many liters of air does he take in during 150 seconds?

Show your work.

d. _____

## Guided Practice

**1.** Out of 30 students surveyed, 17 have a dog. Based on these results, predict how many of the 300 students in the school have a dog? (Example 1)

Show your work.

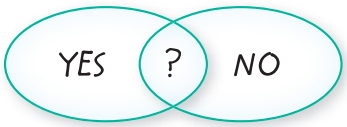
**2.** If one out of 12 students at a school share a locker, how many share a locker in a school of 456 students? (Example 2) _____

**3.** Sybrina jogged 2 miles in 30 minutes. At this rate, how far would she jog in 90 minutes? At what rate did she jog each hour? (Examples 3 and 4)

**4.** **Building on the Essential Question** How can you use diagrams and equations to solve ratio and rate problems?

### Rate Yourself!

Are you ready to move on? Shade the section that applies.




For more help, go online to access a Personal Tutor.

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

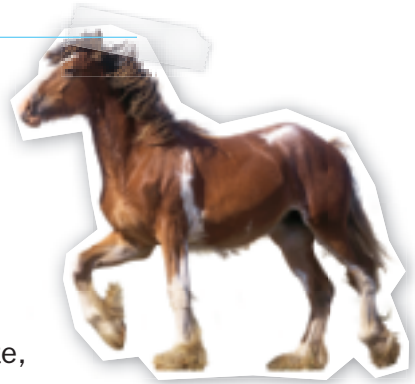
# Independent Practice

Go online for Step-by-Step Solutions eHelp

**1.** If 45 cookies will serve 15 students, how many cookies are needed for 30 students? (Examples 1 and 2)

Show your work.

**2.** Four students spent $12 on school lunch. At this rate, find the amount 10 students would spend on the same school lunch. (Example 3)



**3** A Clydesdale drinks about 120 gallons of water every 4 days. At this rate, about how many gallons of water does a Clydesdale drink in 28 days? (Example 3)

**4.** STEM In 10 minutes, a heart can beat 700 times. At this rate, in how many minutes will a heart beat 140 times? At what rate can a heart beat? (Example 4)

**5** CCSPS **Make a Prediction** The table shows which school subjects are favored by a group of students. Predict the number of students out of 400 that would pick science as their favorite subject.

| Favorite Subject | |
|---|---|
| **Subject** | **Number of Responses** |
| Math | 6 |
| Science | 3 |
| English | 4 |
| History | 7 |

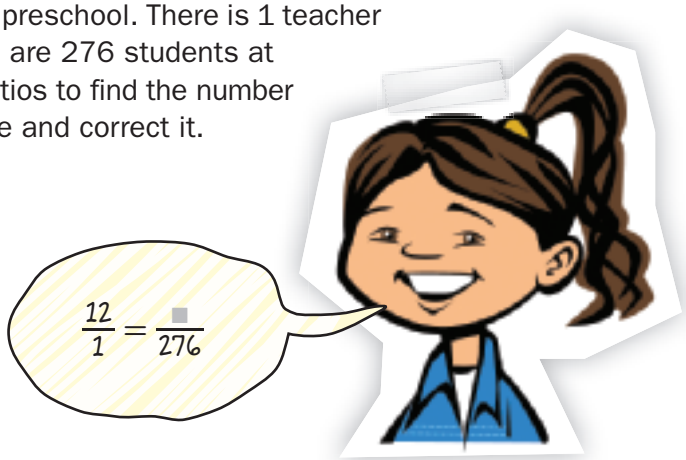
**6.** Liliana takes 4 breaths per 10 seconds during yoga. At this rate, about how many breaths would Liliana take in 2 minutes of yoga?

**7.** CCSPS **Use Math Tools** Find a report in a newspaper or magazine, or on the Internet that uses results from a survey. Evaluate how the survey uses ratios to reach conclusions.

## H.O.T. Problems Higher Order Thinking

**8.** **Identify Structure** One rate of an equivalent ratio is $\frac{9}{n}$. Select two other rates, one that can be solved using equivalent fractions and the other that can be solved with unit rates.

**9.** **Find the Error** Elisa's mom teaches at a preschool. There is 1 teacher for every 12 students at the preschool. There are 276 students at the preschool. Elisa is setting up equivalent ratios to find the number of teachers at the preschool. Find her mistake and correct it.




**10.** **Reason Inductively** Tell whether the following statement is *always, sometimes,* or *never* true for numbers greater than zero. Explain.

*In equivalent ratios, if the numerator of the first ratio is greater than the denominator of the first ratio, then the numerator of the second ratio is greater than the denominator of the second ratio.*

**11.** **Persevere with Problems** Suppose 25 out of 175 people said they like to play disc golf and 5 out of every 12 of the players have a personalized flying disc. At the same rates, in a group of 252 people, predict how many you would expect to have a personalized flying disc.

## Georgia Test Practice

**12.** A car traveling at a certain speed will travel 76 feet per second. How many yards will the car travel in 120 seconds if it maintains the same speed?

Ⓐ 76 yards

Ⓑ 228 yards

Ⓒ 3,040 yards

Ⓓ 9,120 yards

Name _____ My Homework _____

# Extra Practice

**13.** A survey reported that out of 50 teenagers, 9 said they get their news from a newspaper. At this rate, how many out of 300 teenagers would you expect to get their news from a newspaper?

Homework Help

54 teenagers

$\frac{50}{9} = \frac{300}{54}$ (×6 on each side)

**14.** Nata spent $28 on 2 DVDs. At this rate, how much would 5 DVDs cost? At what rate did she spend her money?

**15.** If 15 baseballs weigh 75 ounces, how many baseballs weigh 15 ounces?

**16.** CCSS **Make a Prediction** Suppose 8 out of every 20 students are absent from school less than five days a year. Predict how many students would be absent from school less than five days a year out of 40,000 students.

**17.** For a store contest, 4 out of every 65 people who visit the store will receive a free DVD. If 455 people visit the store, how many DVDs were given away?

**18.** There were 340,000 cattle placed on feed. Write an equivalent ratio that could be used to find how many of these cattle were between 700 and 799 pounds. How many of the 340,000 cattle placed on feed were between 700 and 799 pounds?

| Cattle Placed on Feed | |
|---|---|
| **Weight Group** | **Fraction of Total Cattle** |
| Less than 600 pounds | $\frac{1}{5}$ |
| 600–699 pounds | $\frac{11}{50}$ |
| 700–799 pounds | $\frac{2}{5}$ |
| 800 pounds | $\frac{9}{20}$ |

## Georgia Test Practice

**19.** The ratio of red poms to yellow poms on a float is 5 to 7. If there are 392 yellow poms on the float, how many red poms are there?

Ⓐ 549 Ⓒ 280

Ⓑ 390 Ⓓ 56

**20.** The ratio of green pepper plants to red pepper plants in Adeline's garden is 3 to 5. If there are 20 red pepper plants, how many green pepper plants are there?

Ⓕ 35 Ⓗ 12

Ⓖ 16 Ⓘ 6

**21.** **Short Response** Student Council sells bottled water at the cheerleading competition. At this rate, how many cases of bottled water would they sell in 3 hours? _____

| Cases Sold | 3 | 6 |
|---|---|---|
| Time (min) | 20 | 40 |

**22.** At a bus station, buses depart at a rate of 3 every 10 minutes. At this rate, how many buses would you expect to depart in one hour?

Ⓐ 6 Ⓒ 18

Ⓑ 15 Ⓓ 30

## Common Core Review

**Write each fraction as a unit fraction.** MCC5.NF.5b

**23.** $\frac{12}{84}$ = _____

**24.** $\frac{13}{143}$ = _____

**25.** $\frac{23}{138}$ = _____

**26.** Skylar gained 64 yards on 16 carries during a recent football game. Find the ratio of yards per carry. MCC5.NBT.5

_____

**27.** The drama club is washing cars for a fundraiser. If the rate continues, how many cars will they wash in 4 hours? MCC4.OA.5

| Hours | Cars Washed |
|---|---|
| 1 | 8 |
| 2 | 16 |
| 3 | 24 |

_____

_____

**28.** Follow the rule to find the next three numbers in the pattern. Describe the pattern using the terms *even* and *odd*. MCC4.OA.5

**Add 5:** 1, 6, 11, _____ , _____ , _____ …

_____

# 21ST CENTURY CAREER in Chemistry

## Cosmetic Chemist

Are you naturally curious and analytical? Do you like discovering new things? If so, a career as a cosmetics chemist might be a good choice for you. Cosmetics chemists spend time researching, mixing, and testing new formulas that will make cosmetic products both effective and safe. A cosmetics chemist explained, "When you're developing a product, you play with chemicals and balance ratios to get it to feel right. Basically, it's trial and error."



College & Career READINESS

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## Is This the Career for You?

Are you interested in a career as a cosmetics chemist? Take some of the following courses in high school.

- Algebra
- Biology
- Chemical Science
- Chemistry
- Statistics

Find out how math relates to a career in Chemisty.

## Beauty is Only Science-Deep

**Use the information in the recipes below to solve each problem.**

1. Using the soap recipe, write a ratio comparing the amount of palm kernel oil to the amount of rose hydrosol as a fraction in simplest form. _____

2. Write a ratio to compare the amount of jojoba oil to the total amount of the ingredients in the lip balm recipe. _____

3. The lip balm costs about $16 to make. What is the cost per ounce? _____

4. The soap recipe makes 4 bars of soap. What is the weight per bar? _____

5. The lip balm recipe is increased so that 10 ounces of candelilla wax is needed. Complete the ratio table to find the amount of shea butter that is needed. _____

| | | | | | |
|---|---|---|---|---|---|
| **Candelilla wax** | 2 | | | | 10 |
| **Shea butter** | 6 | | | | |

6. The soap recipe is increased so that 75 grams of shea butter are needed. Complete the ratio table to find the amount of sodium hydroxide that is needed. _____

| | | | |
|---|---|---|---|
| **Shea butter** | 30 | | 75 |
| **Sodium hydroxide** | 42 | | |

**Lip Balm**

4 oz beeswax
2 oz candelilla wax
5 oz jojoba oil
3 oz olive oil
6 oz shea butter

Yield: 20 oz

**Shea Butter Soap**

110 g rose hydrosol
42 g sodium hydroxide
30 g shea butter
66 g coconut oil
150 g olive oil

66 g palm kernel oil
3 tsp calendula $CO_2$
$\frac{3}{4}$ tsp rose essentila oil

Yield: 15 oz

## Career Project

**It's time to update you career portfolio! There are many different types of jobs in cosmetic chemistry. Research one of these jobs and write a two- or three-sentence job description.**

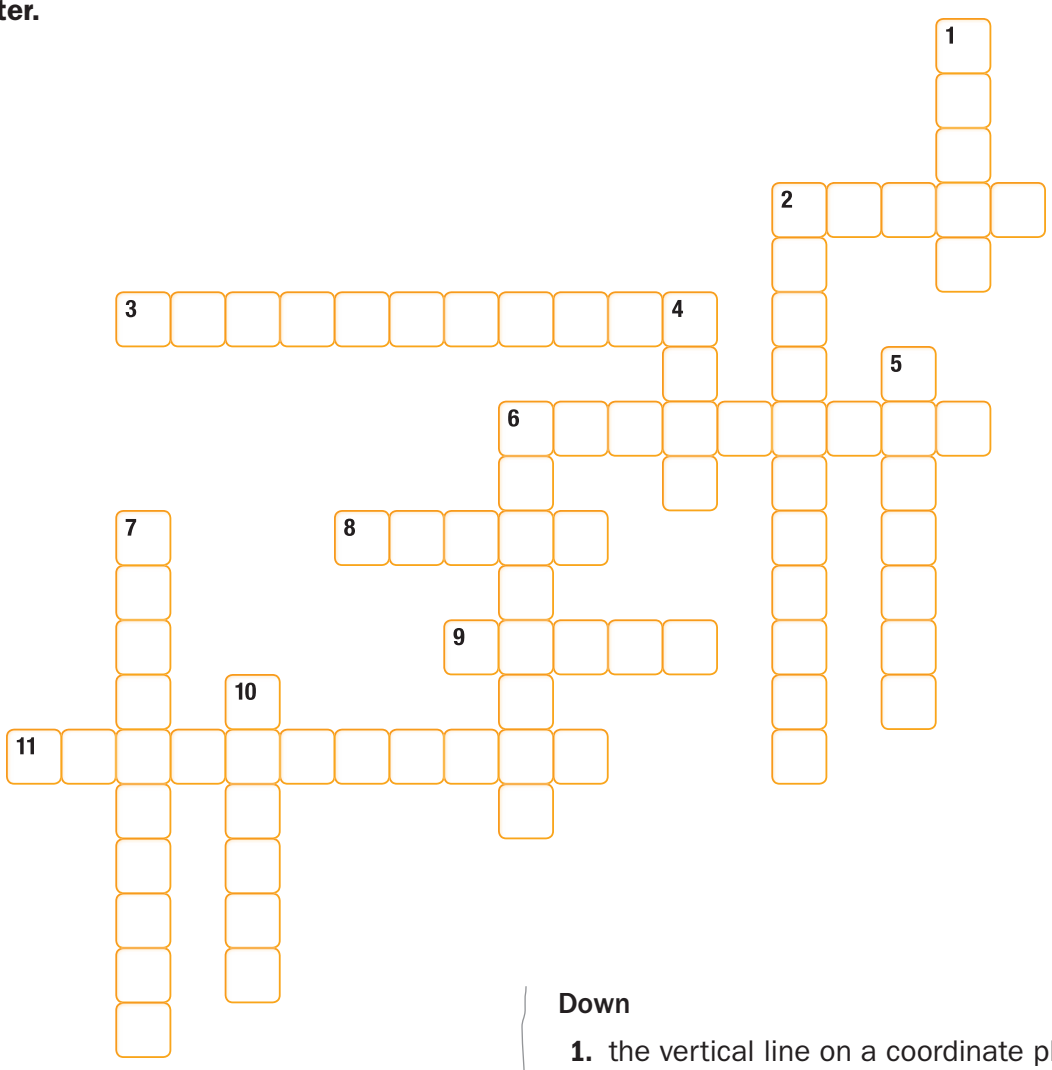
List other careers that someone with an interest in chemistry could pursue.

- _____
- _____
- _____
- _____
- _____

# Chapter Review

## Vocabulary Check

**Complete the crossword puzzle using the vocabulary list at the beginning of the chapter.**




**Across**

**2.** the horizontal line on a coordinate plane

**3.** used to locate a point on the coordinate plane

**6.** the cost per unit

**8.** a comparison of two quantities by division

**9.** to place a dot a the point named by an ordered pair

**11.** the second number of an ordered pair

**Down**

**1.** the vertical line on a coordinate plane

**2.** the first number of an ordered pair

**4.** a ratio comparing two quantities with different kinds of units

**5.** multiply or divide two quantities by the same number

**6.** a rate simplified so that it has a denominator of 1

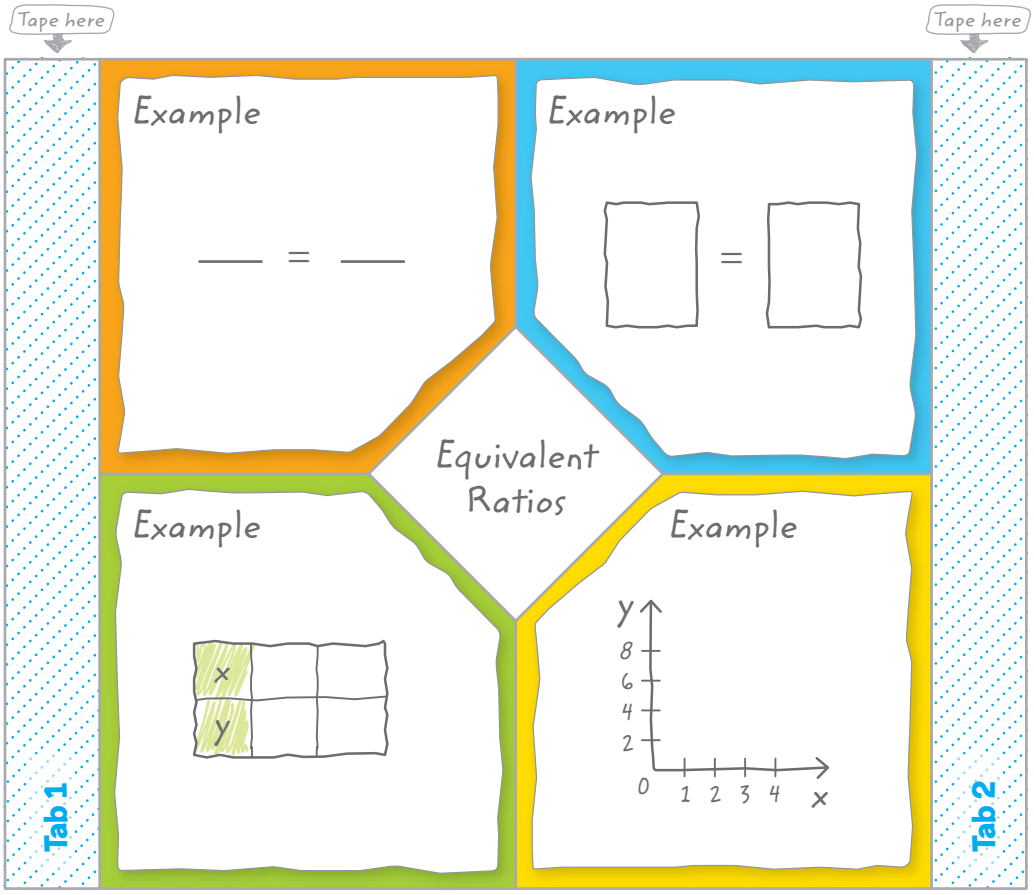
**7.** columns filled with pairs of numbers that have the same ratio

**10.** (0, 0)

# Key Concept Check

## Use Your FOLDABLES

**Use your Foldable to help review the chapter.**




## Got it?

**Match each ratio with an equivalent ratio.**

**1.** 65:390

**2.** $\frac{64}{256}$

**3.** 156:390

**4.** $\frac{204}{306}$

**5.** 56:84

**6.** $\frac{87}{174}$

**a.** $\frac{2}{5}$

**b.** $\frac{2}{3}$

**c.** $\frac{1}{3}$

**d.** $\frac{1}{6}$

**e.** $\frac{1}{4}$

**f.** $\frac{1}{2}$

# Problem Solving

1. Amos has 12 action, 15 comedy, and 9 drama DVDs. Find the ratio of action DVDs to the total number of DVDs. Then explain its meaning. (Lesson 1)

2. A basketball player signs a contract that pays him $16 million over 4 years. What is his average pay per year? (Lesson 2)

3. In a parking lot, 3 out of 8 vehicles were trucks. If there were 128 vehicles, complete the ratio table to find the number of trucks. (Lesson 3)

| | | |
|---|---|---|
| **Number of Trucks** | 3 | |
| **Number of Vehicles** | 8 | 128 |

4. Isabelle bought 12 wallet-sized photos for $36. Use a ratio table to determine how much she will pay for 5 more photos. (Lesson 3)

| | | | |
|---|---|---|---|
| **Number of Photos** | 12 | | 5 |
| **Price ($)** | 36 | | |

5. **Justify Conclusions** The temperature rose 4°F every 90 minutes before noon and rose 2°F every 45 minutes after noon. Are these rates equivalent? Explain your reasoning. (Lesson 5)

6. **Justify Conclusions** Stacey made 8 necklaces in 48 minutes. Nick made 4 necklaces in 24 minutes. Is the rate at which they made necklaces equivalent? Explain your reasoning. (Lesson 5)

7. In the sixth grade, 12 out of 27 students have a dog. If there are 162 students, how many would have a dog? (Lesson 6)

# Reflect

## Answering the Essential Question

**Use what you learned about ratios and rates to complete the graphic organizer.**

**Essential Question**

**HOW do you use equivalent rates in the real world?**

| Ratio |
| --- |
| What is it? |
| Examples |
| Non-examples |

| Rate |
| --- |
| What is it? |
| Examples |
| Non-examples |

| How are rates and ratios the same? |
| --- |
| |

| How are rates and ratios different? |
| --- |
| |

**Answer the Essential Question.** HOW do you use equivalent rates in the real world?