Scientists studying sand structures determined that the perfect sand and water mixture is equal to 1 bucket of water for every 100 buckets of sand. This recipe can be written as the ratio $\frac{1}{100}$. 

**Real-World Video**

Scientists studying sand structures determined that the perfect sand and water mixture is equal to 1 bucket of water for every 100 buckets of sand. This recipe can be written as the ratio $\frac{1}{100}$. 

**GO DIGITAL**

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Complete these exercises to review skills you will need for this module.

**Simplify Fractions**

**EXAMPLE**

Simplify $\frac{15}{24}$.

- List all the factors of the numerator and denominator.
- Circle the greatest common factor (GCF).
- Divide the numerator and denominator by the GCF.

\[
\begin{align*}
15: & \quad 1, \ 3, \ 5, \ 15 \\
24: & \quad 1, \ 2, \ 3, \ 4, \ 6, \ 8, \ 12, \ 24 \\
\end{align*}
\]

\[
\begin{align*}
15 & \div 3 = 5 \\
24 & \div 3 = 8 \\
\end{align*}
\]

Write each fraction in simplest form.

1. $\frac{6}{9}$
2. $\frac{4}{10}$
3. $\frac{15}{20}$
4. $\frac{20}{24}$
5. $\frac{16}{56}$
6. $\frac{45}{72}$
7. $\frac{18}{60}$
8. $\frac{32}{72}$

**Write Equivalent Fractions**

**EXAMPLE**

$\frac{6}{8} = \frac{6 \times 2}{8 \times 2}$

- Multiply the numerator and denominator by the same number to find an equivalent fraction.

\[
\begin{align*}
\frac{6}{8} & = \frac{12}{16} \\
\frac{6}{8} & = \frac{3}{4} \\
\end{align*}
\]

- Divide the numerator and denominator by the same number to find an equivalent fraction.

Write the equivalent fraction.

9. $\frac{12}{15} = \frac{\square}{5}$
10. $\frac{5}{6} = \frac{\square}{30}$
11. $\frac{16}{24} = \frac{\square}{\square}$
12. $\frac{3}{9} = \frac{21}{\square}$
13. $\frac{15}{40} = \frac{\square}{8}$
14. $\frac{18}{30} = \frac{\square}{10}$
15. $\frac{48}{64} = \frac{12}{\square}$
16. $\frac{2}{7} = \frac{18}{\square}$
Reading Start-Up

Visualize Vocabulary

Use the ✓ words to complete the chart. Choose the review words that describe multiplication and division.

<table>
<thead>
<tr>
<th>Understanding Multiplication and Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
</tr>
<tr>
<td>×</td>
</tr>
<tr>
<td>÷</td>
</tr>
</tbody>
</table>

Understand Vocabulary

Match the term on the left to the definition on the right.

1. rate  
2. ratio  
3. unit rate  
4. equivalent ratios

A. Rate in which the second quantity is one unit.
B. Comparison of two quantities by division.
C. Ratios that name the same comparison.
D. Ratio of two quantities that have different units.

Active Reading

Two-Panel Flip Chart Create a two-panel flip chart, to help you understand the concepts in this module. Label one flap “Ratios” and the other flap “Rates.” As you study each lesson, write important ideas under the appropriate flap. Include information about unit rates and any sample equations that will help you remember the concepts when you look back at your notes.
What It Means to You

You will use equivalent ratios to solve real-world problems involving ratios and rates.

**EXAMPLE 6.RP.3**

A group of 10 friends is in line to see a movie. The table shows how much different groups will pay in all. Predict how much the group of 10 will pay.

<table>
<thead>
<tr>
<th>Number in group</th>
<th>3</th>
<th>5</th>
<th>6</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount paid ($)</td>
<td>15</td>
<td>25</td>
<td>30</td>
<td>60</td>
</tr>
</tbody>
</table>

The ratios are all the same.

\[
\frac{3}{15} = \frac{6}{30} = \frac{5}{25} = \frac{12}{60} = \frac{1}{5}
\]

Find the denominator that gives a ratio equivalent to \(\frac{1}{5}\) for a group of 10.

\[
\frac{10}{?} = \frac{1}{5} \quad \rightarrow \quad \frac{10 \div 10}{50 \div 10} = \frac{1}{5} \quad \rightarrow \quad \frac{10}{50} = \frac{1}{5}
\]

A group of 10 will pay $50.

What It Means to You

You will solve problems involving unit rates by division.

**EXAMPLE 6.RP.3b**

A 2-liter bottle of spring water costs $2.02. A 3-liter bottle of the same water costs $2.79. Which is the better deal?

<table>
<thead>
<tr>
<th>2-liter bottle</th>
<th>3-liter bottle</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2.02</td>
<td>$2.79</td>
</tr>
<tr>
<td>2 liters</td>
<td>3 liters</td>
</tr>
<tr>
<td>$2.02 \div 2</td>
<td>$2.79 \div 3</td>
</tr>
<tr>
<td>2 liters \div 2</td>
<td>3 liters \div 3</td>
</tr>
<tr>
<td>$1.01</td>
<td>$0.93</td>
</tr>
<tr>
<td>1 liter</td>
<td>1 liter</td>
</tr>
</tbody>
</table>

The 3-liter bottle is the better deal.
Exploring Ratios

A ratio is a comparison of two quantities. It shows how many times as great one quantity is than another.

For example, the ratio of star-shaped beads to moon-shaped beads in a bracelet is 3 to 1. This means that for every 3 star beads, there is 1 moon bead.

A. Write the ratio of moon beads to star beads.
   ____________

B. Write the ratio of moon beads to all the beads.
   ____________

C. If the bracelet has 2 moon beads, how many star beads does it have?
   ____________

D. If the bracelet has 9 star beads, how many moon beads does it have?
   How do you know?
   ____________
   ____________
   ____________

Reflect

1. Make a Prediction Write a rule that you can use to find the number of star beads in a bracelet when you know the number of moon beads. Then write a rule that you can use to find the number of moon beads when you know the number of star beads.
   ____________
   ____________
   ____________

2. Make a Prediction Write a rule that you can use to find the total number of beads in a bracelet when you know the number of moon beads.
   ____________
Writing Ratios

The numbers in a ratio are called terms. Suppose that in a pet store there are 5 dogs for every 3 cats. The ratio of dogs to cats is 5 to 3. The terms of the ratio are 5 and 3. The ratio can also be written as follows.

5 dogs to 3 cats  \( 5 \) to 3 \( \frac{5}{3} \)

A ratio can compare a part to a part, a part to the whole, or the whole to a part.

EXAMPLE 1

A Write the ratio of comedies to dramas in three different ways.

part to part

Comedies : Dramas \( 8 : 3 \) \( \frac{8}{3} \) 8 comedies to 3 dramas

B Write the ratio of dramas to total videos in three different ways.

part to whole

Dramas : Total videos \( 3 : 14 \) \( \frac{3}{14} \) 3 dramas to 14 total videos

Reflect

3. Interpret the Answer Write and interpret the ratio of cartoons to dramas.

4. Analyze Relationships The ratio of floor seats to balcony seats in a theater is 20:1. Does this theater have more floor seats or more balcony seats? How do you know?

YOUR TURN

Write each ratio in three different ways.

5. bagel chips to peanuts ________________

6. total party mix to pretzels ________________

7. cheese crackers to peanuts ________________

Party Mix

Makes 8 cups

3 cups pretzels
3 cups bagel chips
1 cup cheese crackers
1 cup peanuts
Equivalent Ratios

Equivalent ratios are ratios that name the same comparison. You can find equivalent ratios by using a multiplication table or by multiplying or dividing both terms of a ratio by the same number. So, equivalent ratios have a multiplicative relationship.

A ratio with terms that have no common factors is said to be in simplest form.

EXAMPLE 2

You make 5 cups of punch by mixing 3 cups of cranberry juice with 2 cups of apple juice. How much cranberry juice and how much apple juice do you need to make four times the original recipe?

Method 1 Use a table.

**STEP 1** Make a table comparing the numbers of cups of cranberry juice and apple juice needed to make two times, three times, four times, and five times the original recipe.

<table>
<thead>
<tr>
<th>Cranberry Juice</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple Juice</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

The last column of the table shows the numbers of cups of the two juices you need for four times the original recipe.

You need 12 cups of cranberry juice and 8 cups of apple juice.

Method 2 Multiply both terms of the ratio by the same number.

**STEP 1** Write the original ratio in fraction form.

\[
\frac{3}{2}
\]

**STEP 2** Multiply the numerator and denominator by the same number.

To make four times the original recipe, multiply by 4.

\[
\frac{3 \times 4}{2 \times 4} = \frac{12}{8}
\]

To make four times the original recipe, you will need 12 cups of cranberry juice and 8 cups of apple juice.
The number of dogs compared to the number of cats in an apartment complex is represented by the model shown. (Explore Activity)

1. Write a ratio that compares the number of dogs to the number of cats. _________________
2. Complete the statement: In the apartment complex, there are ________ cats per dog.
3. If there are 15 cats in the apartment complex, how many dogs are there?
   \[15 \div \underline{_______} = \underline{_______} \text{ dogs}\]
4. How many cats are there if there are 5 dogs in the apartment complex?
   \[5 \times \underline{_______} = \underline{_______} \text{ cats}\]

The contents of Dana’s box of muffins are shown. Write each ratio in three different ways. (Example 1)

5. banana nut muffins to corn muffins _________________
6. corn muffins to total muffins _________________

Vocabulary Write three ratios equivalent to the given ratio. Include the simplest form if it is not already given. Circle the simplest form. (Example 2)

7. \[\frac{10}{12} \hspace{1cm} \frac{14}{2} \hspace{1cm} \frac{4}{7}\]
8. \[\frac{8}{10} \hspace{1cm} \frac{5}{2} \hspace{1cm} \frac{5}{2}\]
9. \[\frac{3}{4} \hspace{1cm} \frac{6}{8} \hspace{1cm} \frac{9}{12}\]

Use an example to describe the multiplicative relationship between two equivalent ratios.

Dana’s Dozen Muffins
5 corn
4 bran
2 banana nut
1 blueberry
Interpret each ratio and write three equivalent ratios.

11. The ratio of cups of water to cups of milk in a recipe is 1 to 3.

12. The ratio of peppers to tomatoes in a garden is \( \frac{20}{15} \).

13. In each bouquet of flowers, there are 4 roses and 6 white carnations. Complete the table to find how many roses and carnations there are in 4 bouquets of flowers.

<table>
<thead>
<tr>
<th>Roses</th>
<th>4</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Carnations</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14. Ed is using the recipe shown to make fruit salad. He wants to use 30 diced strawberries in his fruit salad. How many bananas, apples, and pears should Ed use in his fruit salad?

15. **Critique Reasoning** Arsenia has 120 movie posters and 100 band posters. She plans to sell 24 movie posters. She says that if she also sells 24 of the band posters, the ratio of movie posters to band posters in her collection will remain the same. Is that true? Why or why not?

16. Bob needs to mix 2 cups of orange juice concentrate with 3.5 cups of water to make orange juice. Bob has 6 cups of concentrate. How much orange juice can he make?

17. **Multistep** The ratio of North American butterflies to South American butterflies at a butterfly park is 5:3. The ratio of South American butterflies to European butterflies is 3:2. There are 30 North American butterflies at the butterfly park.

   a. How many South American butterflies are there?

   b. How many European butterflies are there?
18. Sinea and Ren are going to the carnival next week. The table shows the amount that each person spent on snacks, games, and souvenirs the last time they went to the carnival.

<table>
<thead>
<tr>
<th></th>
<th>Snacks</th>
<th>Games</th>
<th>Souvenirs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinea</td>
<td>$5</td>
<td>$8</td>
<td>$12</td>
</tr>
<tr>
<td>Ren</td>
<td>$10</td>
<td>$8</td>
<td>$20</td>
</tr>
</tbody>
</table>

a. Write the ratio of the amount Sinea spent on games to the amount she spent on souvenirs. Using this ratio, if she spends $24 on games, how much will she spend on souvenirs?

b. Write the ratio of the amount Ren spent on souvenirs to the amount he spent on snacks. Using this ratio, if he spends $12 on snacks, how much will he spend on souvenirs?

c. Use the ratio comparisons indicated by the data in the table. If Sinea spends $15 on snacks next week, how much will Ren spend on snacks? How much will he spend on souvenirs? Explain.

19. Multiple Representations The diagram compares the ratio of girls in the chorus to boys in the chorus. What is the ratio of girls to boys? If there are 50 students in the chorus, how many are girls and how many are boys?

20. Analyze Relationships How is the process of finding equivalent ratios like the process of finding equivalent fractions?

21. Explain the Error Tina says that 6:8 is equivalent to 36:64. What did Tina do wrong?
**EXPLORE ACTIVITY**

**Using Rates to Compare Prices**

A **rate** is a comparison of two quantities that have different units.

Chris drove 107 miles in two hours. This can be expressed as \( \frac{107 \text{ miles}}{2 \text{ hours}} \). Notice that the units are different: miles and hours.

Shana is at the grocery store comparing two brands of juice. Brand A costs $3.84 for a 16-ounce bottle. Brand B costs $4.50 for a 25-ounce bottle.

To compare the costs, Shana must compare prices for equal amounts of juice. How can she do this?

**A** Complete the tables.

<table>
<thead>
<tr>
<th>Ounces</th>
<th>Price ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>3.84</td>
</tr>
<tr>
<td>8</td>
<td>1.92</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ounces</th>
<th>Price ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>4.50</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**B** Brand A costs $ \( \frac{3.84}{16} \) per ounce.

Brand B costs $ \( \frac{4.50}{25} \) per ounce.

**C** Which brand is the better buy? Why? ________________

**Reflect**

1. **Analyze Relationships** Describe another method to compare the costs.

   ________________
Calculating Unit Rates

A unit rate is a rate in which the second quantity is one unit. When the first quantity in a unit rate is an amount of money, the unit rate is sometimes called a unit price or unit cost.

**EXAMPLE 1**

A. Gerald signs up for the classes shown. What is the cost per class?

Use the information in the problem to write a rate:\n\[
\frac{90}{6 \text{ classes}}
\]

To find the unit rate, divide both quantities in the rate by the same number so that the second quantity is 1.

\[
\frac{90}{6 \text{ classes}} = \frac{15}{1 \text{ class}}
\]

Gerald's yoga classes cost $15 per class.

B. The cost of 2 cartons of milk is $5.50. What is the unit price?

The unit price is $2.75 per carton of milk.

C. A cruise ship travels 20 miles in 50 minutes. How far does the ship travel per minute?

The ship travels 0.4 mile per minute.

**Reflect**

2. **Critical Thinking** How can you write any rate as a unit rate?

3. **Multiple Representations** Explain how you could use a diagram like the one shown below to find the unit rate in A. Then complete the diagram to find the unit rate.

Math Talk

Mathematical Practices

6.RP.2
4. There are 156 players on 13 teams. How many players are on each team? _______ players

Problem Solving with Unit Rates
You can solve rate problems by using a unit rate or by using equivalent rates.

EXAMPLE 2
At a summer camp, the campers are divided into groups. Each group has 16 campers and 2 cabins. How many cabins are needed for 112 campers?

Method 1 First write the given rate as a unit rate.

\[
\frac{16 \text{ campers}}{2 \text{ cabins}} = \frac{8 \text{ campers}}{1 \text{ cabin}} \quad \text{There are 8 campers per cabin.}
\]

Then divide the number of campers by the unit rate.

\[
112 \text{ campers} \div 8 \text{ campers per cabin} = 14 \text{ cabins}
\]

Method 2 Use equivalent rates.

\[
\frac{16 \text{ campers}}{2 \text{ cabins}} = \frac{112 \text{ campers}}{\square \text{ cabins}} \quad \text{Ask: 16 times what factor equals 112?}
\]

\[
\frac{16 \text{ campers}}{2 \text{ cabins}} = \frac{112 \text{ campers}}{14 \text{ cabins}} \quad \text{Multiply the denominator by this factor.}
\]

The camp needs 14 cabins.

Check Use a diagram to check that the unit rate is 8 campers to 1 cabin.

\[
\begin{array}{c}
\text{16 campers} \\
\text{2 cabins}
\end{array}
\]

\[
\begin{array}{c}
\text{8 campers} \\
\text{8 campers}
\end{array}
\]

Then use the unit rate to check the answer.

Because \(8 \times 14 = 112\), the answer is correct. That is, 14 cabins are needed.
Guided Practice

Mason’s favorite brand of peanut butter is available in two sizes. Each size and its price are shown in the table. Use the table for 1 and 2. (Explore Activity)

1. What is the unit rate for each size of peanut butter?
   - Regular: $ \_ \_ \_ \_ \_ \_ \_ \_ per ounce
   - Family size: $ \_ \_ \_ \_ \_ \_ \_ \_ per ounce

2. Which size is the better buy? ______________

3. Martin charges $10 for every 5 bags of leaves he rakes. Last weekend, he raked 24 bags of leaves. Complete the diagram and the equivalent rates to find how much he earned. (Examples 1 and 2)

$10

5 bags of leaves

1 bag of leaves

Find the unit rate. (Example 1)

4. Lisa walks 48 blocks in 3 hours. ______________ blocks per hour

5. Gordon types 1,800 words in 25 minutes. ______________ words per minute

6. A particular frozen yogurt has 75 calories in 2 ounces. How many calories are in 8 ounces of the yogurt? (Example 2)

7. The cost of 10 oranges is $1. What is the cost of 5 dozen oranges? (Example 2)

8. How can you use a rate to compare the costs of two boxes of cereal that are different sizes?

5. Petra jogs 3 miles in 27 minutes. Find the unit rate in minutes per mile. How long would it take her to jog 5 miles? Show your work.

ESSENTIAL QUESTION CHECK-IN

8. How can you use a rate to compare the costs of two boxes of cereal that are different sizes?
Taryn and Alastair both mow lawns. Each charges a flat fee to mow a lawn. The table shows the number of lawns mowed in the past week, the time spent mowing lawns, and the money earned.

<table>
<thead>
<tr>
<th>Number of Lawns Mowed</th>
<th>Time Spent Mowing Lawns (in hours)</th>
<th>Money Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taryn</td>
<td>9</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>$112.50</td>
<td></td>
</tr>
<tr>
<td>Alastair</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>$122.50</td>
<td></td>
</tr>
</tbody>
</table>

9. How much does Taryn charge to mow a lawn? ________________

10. How much does Alastair charge to mow a lawn? ________________

11. Who earns more per hour, Taryn or Alastair? ________________

12. **What If?** If Taryn and Alastair want to earn an additional $735 each, how many additional hours will each spend mowing lawns? Assume each mows at the rate shown in the table and charges by the hour. Explain.

13. **Multistep** Tomas makes balloon sculptures at a circus. In 180 minutes, he uses 252 balloons to make 36 identical balloon sculptures.

   a. How many minutes does it take to make one balloon sculpture? How many balloons are used in one sculpture? ________________

   b. What is Tomas's unit rate for balloons used per minute? ________________

   c. Complete the diagram to find out how many balloons he will use in 10 minutes.

   ![Diagram of balloons and minutes]
14. Abby can buy an 8-pound bag of dog food for $7.40 or a 4-pound bag of the same dog food for $5.38. Which is the better buy?

15. A bakery offers a sale price of $3.50 for 4 muffins. What is the price per dozen?

16. Mrs. Jacobsen wants to order toy instruments to give as prizes to her music students. The table shows the prices for various order sizes.

<table>
<thead>
<tr>
<th></th>
<th>25 items</th>
<th>50 items</th>
<th>80 items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whistles</td>
<td>$21.25</td>
<td>$36.00</td>
<td>$60.00</td>
</tr>
<tr>
<td>Kazoos</td>
<td>$10.00</td>
<td>$18.50</td>
<td>$27.20</td>
</tr>
</tbody>
</table>

a. What is the difference between the highest unit price for whistles and the lowest unit price for whistles?

b. What is the highest unit price per kazoo?

c. Persevere in Problem Solving To get the lowest unit price, which item and how many of that item would Mrs. Jacobsen have to order?

17. Draw Conclusions There are 2.54 centimeters in 1 inch. How many centimeters are there in 1 foot? in 1 yard? Explain your reasoning.

18. Critique Reasoning A 2-pound box of spaghetti costs $2.50. Philip says that the unit cost is \( \frac{2}{2.50} = 0.80 \) per pound. Explain his error.

19. Look for a Pattern A grocery store sells three different quantities of sugar. A 1-pound bag costs $1.10, a 2-pound bag costs $1.98, and a 3-pound bag costs $2.64. Describe how the unit cost changes as the quantity of sugar increases.
EXPLORE ACTIVITY 1

Using Tables to Compare Ratios

Anna’s recipe for lemonade calls for 2 cups of lemonade concentrate and 3 cups of water. Bailey’s recipe calls for 3 cups of lemonade concentrate and 5 cups of water.

A In Anna’s recipe, the ratio of concentrate to water is ________________. Use equivalent ratios to complete the table.

<table>
<thead>
<tr>
<th>Concentrate (c)</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (c)</td>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>

B In Bailey’s recipe, the ratio of concentrate to water is ________________. Use equivalent ratios to complete the table.

<table>
<thead>
<tr>
<th>Concentrate (c)</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (c)</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>25</td>
</tr>
</tbody>
</table>

C Find two columns, one in each table, in which the amount of water is the same. Circle these two columns.

D Whose recipe makes stronger lemonade? How do you know?

E Compare the ratios: \( \frac{10}{15} \)  \( \frac{9}{15} \)  \( \frac{2}{3} \)  \( \frac{3}{5} \)
Comparing Ratios

You can use equivalent ratios to solve real-world problems.

**EXAMPLE 1**

A fruit and nut bar recipe calls for 4 cups of chopped nuts and 6 cups of dried fruit. Tonya increased the recipe. She used 6 cups of chopped nuts and 9 cups of dried fruit. Did Tonya use the correct ratio of nuts to fruit?

**STEP 1**
Find the ratio of nuts to fruit in the recipe.

\[ \frac{4}{6} \text{ cups of nuts to 6 cups of fruit} \]

**STEP 2**
Find the ratio of nuts to fruit that Tonya used.

\[ \frac{6}{9} \text{ cups of nuts to 9 cups of fruit} \]

**STEP 3**
Find equivalent ratios that have the same second term.

\[ \frac{4}{6} \times \frac{3}{3} = \frac{12}{18} \]
\[ \frac{6}{9} \times \frac{2}{2} = \frac{12}{18} \]

The ratios \( \frac{4}{6} \) and \( \frac{6}{9} \) are equivalent. So, Tonya used the same ratio of nuts to fruit that was given in the recipe.

**YOUR TURN**

2. In the science club, there are 2 sixth-graders for every 3 seventh-graders. At this year’s science fair, there were 7 projects by sixth-graders for every 12 projects by seventh-graders. Is the ratio of sixth-graders to seventh-graders in the science club equivalent to the ratio of science fair projects by sixth-graders to projects by seventh-graders? Explain.
Using Rates to Make Predictions

Janet drives from Clarkson to Humboldt in 2 hours. Suppose Janet drives for 10 hours. If she maintains the same driving rate, can she drive more than 600 miles? Justify your answer.

A double number line is useful because the regular intervals represent equivalent rates that compare different quantities. The one shown compares the number of miles driven to the time driven for different amounts of time.

A. Use the double number line to identify Janet’s rate for two hours.

B. Describe the relationship between Janet’s rate for two hours and the other rates shown on the double number line.

C. Complete the number line.

D. If Janet maintains the same driving rate, can she drive more than 600 miles in 10 hours? Explain.

Reflect

3. In 15 minutes, Lena can finish 2 math problems. At that rate, how many math problems can she finish in 75 minutes? Use a double number line to find the answer.

4. How could you use a unit rate to answer part D?
1. Celeste is making fruit baskets for a local hospital. The directions say to use 5 apples for every 6 oranges. Celeste is filling her baskets with 2 apples for every 3 oranges. (Explore Activity 1)
   a. Complete the tables to find equivalent ratios. Circle two columns, one in each table, in which the number of oranges is the same.

<table>
<thead>
<tr>
<th>Apples</th>
<th>Oranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Apples</th>
<th>Oranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

   b. Compare the ratios. Is Celeste using the correct ratio of apples to oranges? Explain.

2. Neha used 4 bananas and 5 oranges in her fruit salad. Daniel used 7 bananas and 9 oranges. Did Neha and Daniel use the same ratio of bananas to oranges? If not, who used the greater ratio of bananas to oranges? Explain. (Example 1)

3. Tim is a first grader and reads 28 words per minute. Assuming he maintains the same rate, use the double number line to decide if he can read 150 words in 5 minutes. (Explore Activity 2)

<table>
<thead>
<tr>
<th>Words</th>
<th>0</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

4. A cafeteria sells 30 drinks every 15 minutes. Predict whether, at that rate, the cafeteria will sell at least 90 drinks every hour. (Explore Activity 2)

5. What must you assume when you use a rate to make a prediction?
6. Gina’s art teacher mixes 9 pints of yellow paint with 6 pints of blue paint to create green paint. Gina mixes 4 pints of yellow paint with 3 pints of blue paint. Did Gina use the same ratio of yellow paint to blue paint that her teacher used? Explain.

7. The Suarez family paid $23.25 for 3 movie tickets. At that rate, could the family use a $100 gift certificate to buy 12 tickets?

8. A store sells snacks by weight. A six ounce bag of mixed nuts costs $3.60. Will a two ounce bag of nuts cost more than or less than $1.25?

9. Sue’s car used 12 gallons of gas on a 300 mile trip. Jen’s car used 5 gallons of gas on a 140 mile trip. Whose car got more miles per gallon?

10. Multistep The table shows two cell phone plans that offer free minutes for each given number of paid minutes used. Pablo has Plan A and Sam has Plan B.

   a. What is Pablo’s ratio of free to paid minutes?

   b. What is Sam’s ratio of free to paid minutes?

   c. Does Pablo’s cell phone plan offer the same ratio of free to paid minutes as Sam’s? Explain.

11. Consumer Math A store has apples on sale at $3.00 for 2 pounds.

   a. How many pounds of apples can you buy for $9? Explain.

   b. Suppose each of the apples weighs about 5 ounces. Can you buy 24 apples for $9? Explain.
12. **Science** One California fan palm tree grew 85 inches in 5 years. A queen palm tree grew 96 inches in 8 years. Which tree grew faster? Explain.

13. Theo drove 228 miles in 4 hours. Lex drove 186 miles in 3 hours. At those rates, could either man drive 112 miles in 2 hours? Explain.

14. One fabric costs $15.00 for two yards. Another costs $37.50 for 5 yards. Do these fabrics have the same unit cost? Explain.

15. **Problem Solving** Complete each ratio table.

<table>
<thead>
<tr>
<th></th>
<th>12</th>
<th>18</th>
<th>24</th>
<th>80.8</th>
<th>40.4</th>
<th>10.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td></td>
<td></td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>512</td>
<td>256</td>
<td></td>
</tr>
</tbody>
</table>

16. **Represent Real-World Problems** Write a real-world problem that compares the ratios 5 to 9 and 12 to 15.

17. **Analyze Relationships** Explain how you can be sure that all the rates you have written on a double number line are correct.

18. **Draw Conclusions** Paul can choose to be paid $50 for a job, or he can be paid $12.50 per hour. Under what circumstances should he choose the hourly wage? Explain.
6.1 Ratios

Use the table to find each ratio.

1. white socks to brown socks __________
2. blue socks to nonblue socks __________
3. black socks to all of the socks __________
4. Find two ratios equivalent to the ratio in Exercise 1.
   ________________________________

<table>
<thead>
<tr>
<th>Color of socks</th>
<th>white</th>
<th>black</th>
<th>blue</th>
<th>brown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of socks</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

6.2 Rates

Find each rate.

5. Earl runs 75 meters in 30 seconds. How many meters does Earl run per second? __________
6. The cost of 3 scarves is $26.25. What is the unit price? __________

6.3 Using Ratios and Rates to Solve Problems

7. Danny charges $35 for 3 hours of swimming lessons. Martin charges $24 for 2 hours of swimming lessons. Who offers a better deal? __________
8. There are 32 female performers in a dance recital. The ratio of men to women is 3 : 8. How many men are in the dance recital? __________

9. How can you use ratios and rates to solve problems?
   ________________________________
   ________________________________
   ________________________________
   ________________________________
   ________________________________
   ________________________________
1. Consider each set of ratios. Are all of the ratios equivalent?

Select Yes or No for the sets of ratios in A–C.

A. \(\frac{2}{3}, \frac{6}{9}, \frac{18}{24}\)
   - Yes
   - No

B. \(\frac{4}{20}, \frac{5}{25}, \frac{6}{30}\)
   - Yes
   - No

C. \(12 : 20, 30 : 50, 75 : 125\)
   - Yes
   - No

2. Sheila can ride her bicycle 6,000 meters in 15 minutes. Cal can ride his bicycle 3,400 meters in 8 minutes.

Choose True or False for each statement.

A. Sheila can ride her bicycle 800 meters in 2 minutes.
   - True
   - False

B. Cal can ride his bicycle 750 meters in 1 minute.
   - True
   - False

C. Cal rides at a slower speed than Sheila.
   - True
   - False

3. A total of 64 musicians entered a music contest, and \(\frac{5}{8}\) of these musicians are guitarists. Some of the guitarists play jazz solos, and the rest play classical solos. The ratio of the number of guitarists playing jazz solos to the total number of guitarists in the contest is 1:4. How many guitarists play classical solos in the contest? Explain your reasoning.

4. Mikaela is competing in a race in which she both runs and rides a bicycle. She runs 4.5 kilometers in 0.5 hour and rides her bicycle 18.75 kilometers in 0.75 hour. If she runs for 1 hour and bikes for 1 hour at the same rates as she does in the race, how far will she travel? Explain your reasoning.