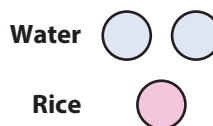


## Dear Family,

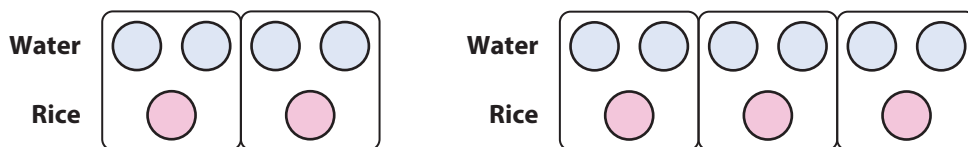
This week your student is learning how to find equivalent ratios.

**Equivalent ratios** are ratios that express the same comparison. For example, a rice recipe might require **2** cups of water for every **1** cup of rice.



If you double the recipe, the ratio of cups of water to cups of rice is **4** to **2**.

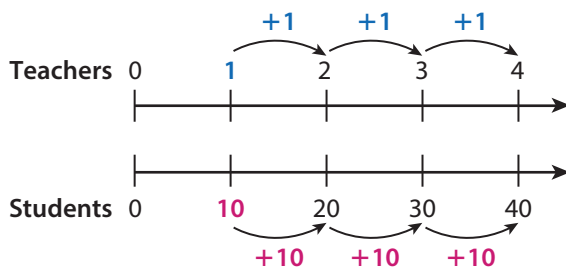
If you triple the recipe, the ratio of cups of water to cups of rice is **6** to **3**.



Your student will be learning how to solve problems like the one below.

On a school field trip, there must be 1 teacher for every 10 students. If 40 students attend the field trip, how many teachers are needed?

► **ONE WAY** to find the number of teachers is to use addition.



► **ANOTHER WAY** is to use multiplication.

		$\times 4$			
<b>Teachers</b>	<b>1</b>	2	3	4	
<b>Students</b>	<b>10</b>	20	30	40	
		$\times 4$			

Using either method, 4 teachers are needed for the field trip.



Use the next page to start a conversation about ratios.

## Activity Thinking About Ratios Around You

- ▶ **Do this activity together to investigate ratios in the real world.**

Have you ever watched a movie on TV and wondered why long black bars appear on the top and bottom of the screen? This happens because the ratios of width to length for TVs and movie screens are not equivalent!

Most TVs have 16 in. of width for every 9 in. of height. Most movie screens have 21.51 in. of width for every 9 in. of height. Without the long black bars, movies watched on TV might look stretched too tall.



**?** Where else do you see equivalent or non-equivalent ratios in the world around you?

A large rectangular area filled with a light blue grid pattern. This area is intended for students to write their responses to the question above. The grid lines are thin and spaced evenly, providing a guide for handwriting.

# Explore Equivalent Ratios

Previously, you learned how to compare quantities by using ratios. In this lesson, you will learn about equivalent ratios.

► Use what you know to try to solve the problem below.

Veda uses henna paste to paint designs on her friends' hands and feet as they prepare to celebrate Diwali, a festival of lights. What is the ratio of tablespoons of henna powder to teaspoons of oil if Veda makes 3 batches of paste?

**TRY IT**



**Math Toolkit** connecting cubes, counters, grid paper



**DISCUSS IT**

**Ask:** How does your model show 3 batches of paste?

**Share:** My model shows that . . .



**Learning Targets** SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6

Use ratio and rate reasoning to solve real-world and mathematical problems.

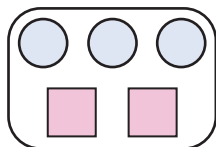
- Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.

## CONNECT IT

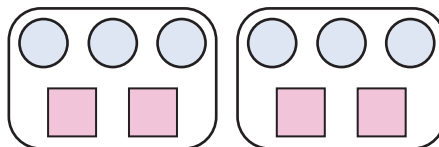
- 1 **Look Back** What is the ratio of tablespoons of henna powder to teaspoons of oil for 3 batches of henna paste? Explain how you know.

- 2 **Look Ahead Equivalent ratios** are ratios that express the same comparison.

- a. To find a ratio that is equivalent to the ratio 3 to 2, you can combine equal groups of 3 circles and 2 squares. How does the model show that the ratios 3 : 2 and 6 : 4 are equivalent ratios?



3 circles to 2 squares



6 circles to 4 squares

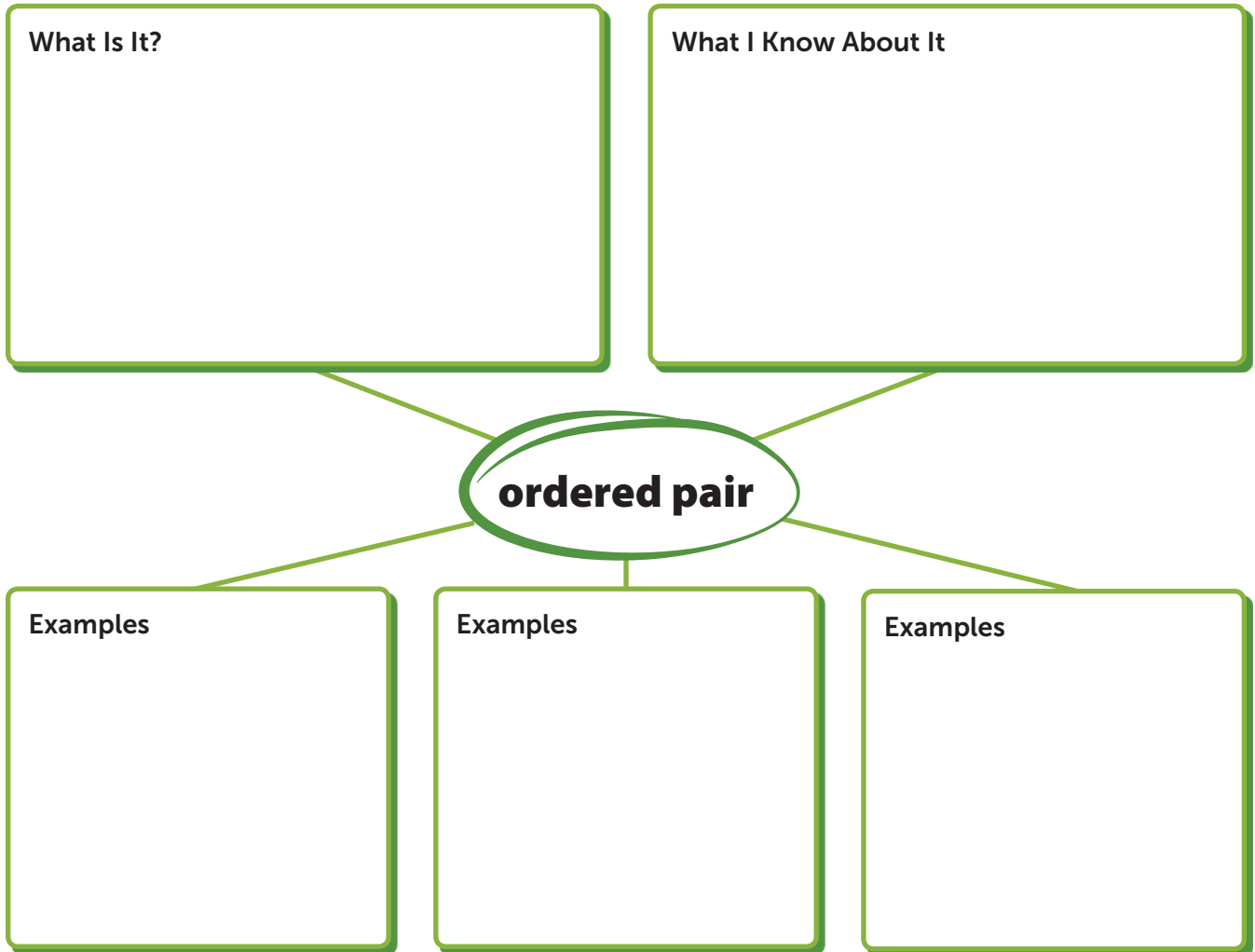
- b. Find another ratio that is equivalent to 3 : 2. Use a model to support your answer.

- c. Explain why 3 : 2 and 9 : 8 are not equivalent ratios.

- 3 **Reflect** How can you tell whether two ratios are equivalent?

# Prepare for Finding Equivalent Ratios

- 1 Think about what you know about ordered pairs. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.



- 2 Do the ordered pairs  $(1, 4)$  and  $(4, 1)$  represent the same point in the coordinate plane? Explain.

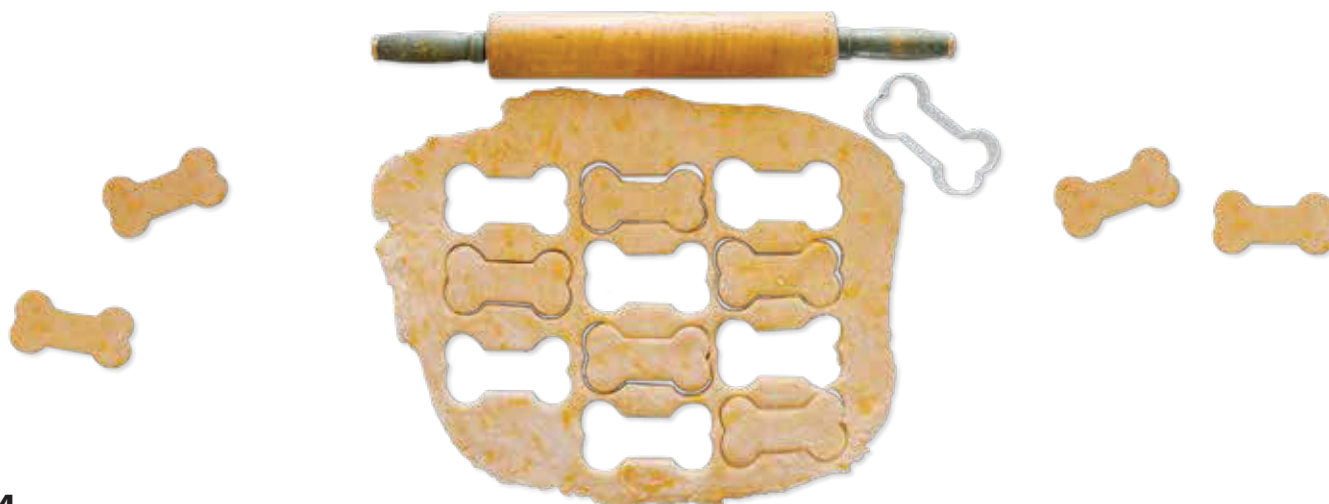
- 3 Felipe has a recipe for peanut butter dog treats.
- a. What is the ratio of cups of flour to tablespoons of peanut butter if Felipe makes 3 batches of dog treats? Show your work.

Dog Treats (1 batch)	
Ingredient	Amount
Peanut Butter	4 tbsp
Flour	1 cup
Egg	1
Water	2 tbsp

**SOLUTION** \_\_\_\_\_

\_\_\_\_\_

- b. Check your answer to problem 3a. Show your work.



# Develop Finding Equivalent Ratios



► Read and try to solve the problem below.

The ratio of picnic tables to garbage cans in a new national park should be 8 : 3. The park design shows plans for picnic tables in a small campground and a large campground. How many garbage cans should there be in each campground?

### Number of Picnic Tables



**TRY  
IT**



**Math Toolkit** connecting cubes, counters, double number lines, grid paper

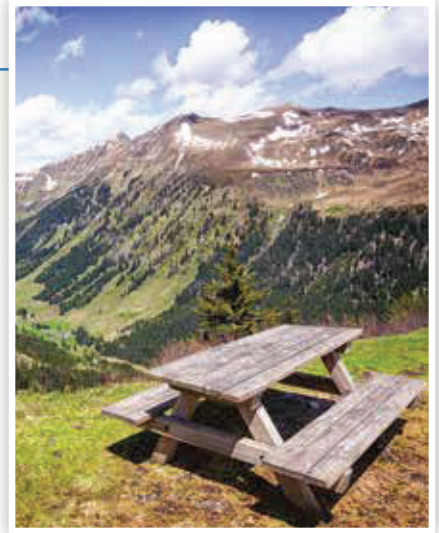
### DISCUSS IT

**Ask:** How did you use the ratio 8 : 3 to find the number of garbage cans for 40 picnic tables?

**Share:** I used the ratio 8 : 3 when I . . .

► Explore different ways to find equivalent ratios.

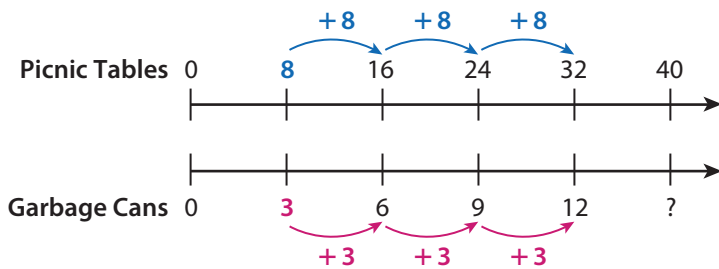
The ratio of picnic tables to garbage cans in a new national park should be 8 : 3. The park design shows 40 picnic tables in a small campground and 120 picnic tables in a large campground. How many garbage cans should there be in each campground?



**Model It**

You can use addition to find equivalent ratios.

One way to show adding groups of **8 picnic tables** for every **3 garbage cans** is with a double number line.

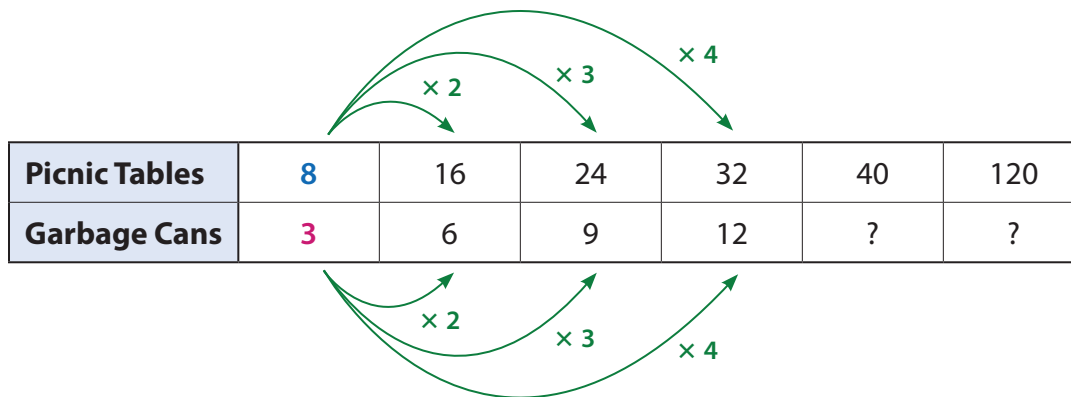


You can write ratios for number pairs that line up vertically. The double number line shows the equivalent ratios 8 : 3, 16 : 6, 24 : 9, and 32 : 12.

**Model It**

You can use multiplication to find equivalent ratios.

You can record equivalent ratios in a table.





## CONNECT IT

► Use the problem from the previous page to help you understand how to find equivalent ratios.

- 1 Look at the first **Model It**. How do you know that the ratios from the double number line are equivalent ratios?
- 2 Look at the second **Model It**. What number can you multiply 8 by to get 120? How can you use this number to solve part of the problem?
- 3 How many garbage cans should be placed in each campground? Explain how you can use addition or multiplication to find the answer.
- 4 Why can you multiply both quantities in a ratio by the same number to find an equivalent ratio?
- 5 Cai says you can divide both quantities in a ratio by the same nonzero number to find an equivalent ratio. Explain why Cai is correct.
- 6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to find equivalent ratios.

## Apply It

► Use what you learned to solve these problems.

- 7 Hailey makes a necklace with 24 blue beads and 32 purple beads. She wants to make a bracelet that uses the same ratio of blue beads to purple beads. She plans to use 6 blue beads for the bracelet. How many purple beads should Hailey use?
- A 4 purple beads
- B 8 purple beads
- C 14 purple beads
- D 18 purple beads
- 8 Kareem says that the ratio 4 : 1 is equivalent to the ratio 12 : 9 because  $4 + 8 = 12$  and  $1 + 8 = 9$ . Is Kareem correct? Explain how you know.
- 9 The table shows that Marta's heart beats 18 times every 15 s. Use equivalent ratios to complete the table. Explain how you found the time in seconds for 180 heartbeats.

Marta's Heartbeats	
Time (s)	Number of Beats
15	18
30	
45	
	180



## Practice Finding Equivalent Ratios

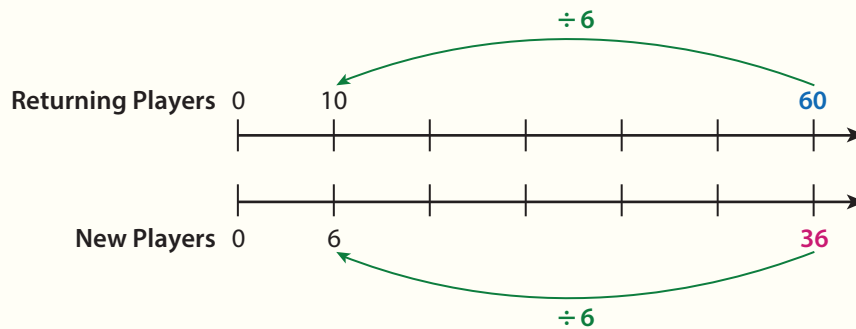
- Study the Example showing how to find equivalent ratios. Then solve problems 1–5.

### Example

A soccer league has 60 returning players and 36 new players. Each team will have the same ratio of returning players to new players as the league has. How many new players will a team with 10 returning players have?

You can use a double number line to find ratios equivalent to  $60 : 36$ .

Number pairs that line up vertically represent equivalent ratios.



You can divide each quantity in  $60 : 36$  by 6 to find the equivalent ratio  $10 : 6$ .

A team with 10 returning players will have 6 new players.

- 1 Sophia says that you can solve the problem in the Example by multiplying both quantities in the ratio  $60 : 36$  by  $\frac{1}{6}$ . Is Sophia correct? Explain.

- 2 Which ratios are equivalent to  $8 : 12$ ? Select all that apply.

- A 4 : 6
- B 12 : 8
- C 16 : 20
- D 24 : 36
- E 56 : 84

### Vocabulary

#### equivalent ratios

two ratios that express the same comparison.

Multiplying both numbers in the ratio  $a : b$  by a nonzero number  $n$  results in the equivalent ratio  $na : nb$ .

- 3 A football field is 300 ft long. A sloth moving very quickly travels 60 ft every 5 min. Based on this ratio, how many minutes would it take a sloth to travel the length of a football field? Show your work.



**SOLUTION** \_\_\_\_\_

- 4 At a summer camp, the ratio of campers to adults is kept equivalent to 7 : 1.
- a. Use equivalent ratios to complete the table.

<b>Campers</b>	7		28	
<b>Adults</b>	1	2		30

- b. Next week, there will be 63 campers. How many adults should the camp have next week? Show your work.

**SOLUTION** \_\_\_\_\_

- 5 A manager of a clothing store always orders 2 small T-shirts and 3 large T-shirts for every 4 medium T-shirts. The manager plans to order 24 medium T-shirts. How many small T-shirts and large T-shirts should the manager order? Show your work.

**SOLUTION** \_\_\_\_\_

# Develop Graphing a Table of Equivalent Ratios

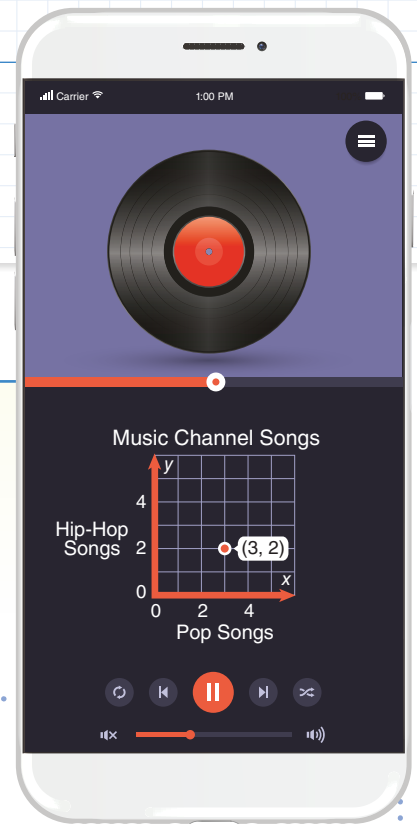
► Read and try to solve the problem below.

A streaming music channel always plays the same ratio of pop songs to hip-hop songs. The point on the graph shows the number of hip-hop songs played for every 3 pop songs. Based on the relationship in the graph, how many hip-hop songs does the channel play for every 12 pop songs?

**TRY IT**



**Math Toolkit** connecting cubes, counters, double number lines, graph paper



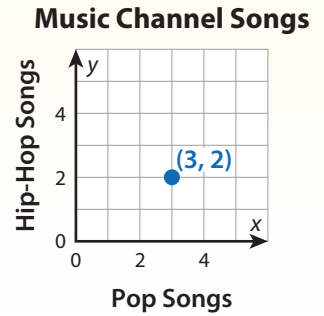
## DISCUSS IT

**Ask:** How does your model use the ordered pair from the graph?

**Share:** In my model, I used the ordered pair to ...

➤ Explore different ways to use a graph to show equivalent ratios.

A streaming music channel always plays the same ratio of pop songs to hip-hop songs. The point on the graph shows the number of hip-hop songs played for every 3 pop songs. Based on the relationship in the graph, how many hip-hop songs does the channel play for every 12 pop songs?



**Model It**

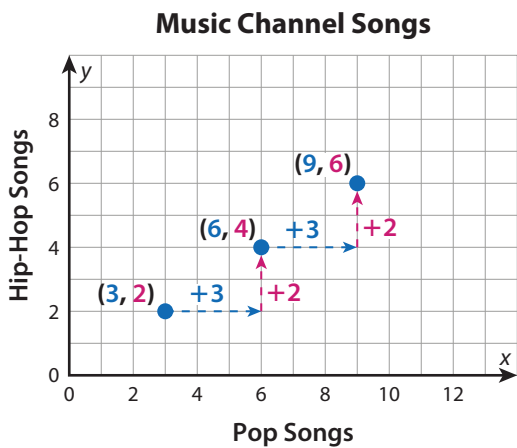
You can make a table of equivalent ratios from the given ordered pair.

The ordered pair (3, 2) shows that the ratio of **pop songs** to **hip-hop songs** is 3 : 2.

	Pop Songs, x	Hip-Hop Songs, y	
+ 3	3	2	+ 2
+ 3	6	4	+ 2
+ 3	9	6	+ 2
	12	?	

**Model It**

You can use the coordinates of the given ordered pair to find other ordered pairs that represent equivalent ratios.



## CONNECT IT

► Use the problem from the previous page to help you understand how to use a graph to show equivalent ratios.

- 1 How does the graph in the problem show that the ratio of pop songs to hip-hop songs is 3 : 2?
- 2 Look at the table in the first **Model It** and the graph in the second **Model It**. How is the addition pattern in the graph related to the addition pattern in the table?
- 3 How many hip-hop songs does the streaming music channel play for every 12 pop songs? Plot a point on the graph to model this relationship.
- 4 How can you use a point on a graph to find another point that represents an equivalent ratio? Explain why your method works.
- 5 How could you use ordered pairs and multiplication to find equivalent ratios?
- 6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand using a graph to show equivalent ratios.

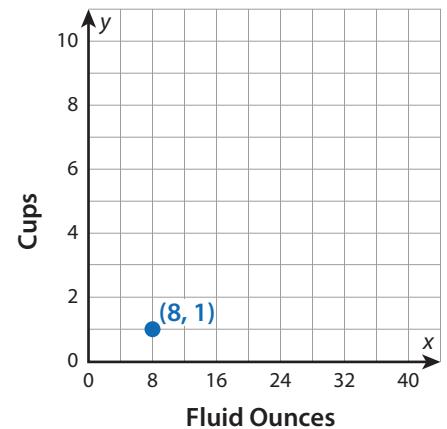
## Apply It

► Use what you learned to solve these problems.

- 7 The ratio of the length of a fire hose in feet to the number of gallons of water the hose can hold is 100 : 4. Complete the table of equivalent ratios. Then write each ratio as an ordered pair.

Hose Length (ft)	Volume of Water (gal)	Ordered Pair
	1	
50		
100	4	
	12	

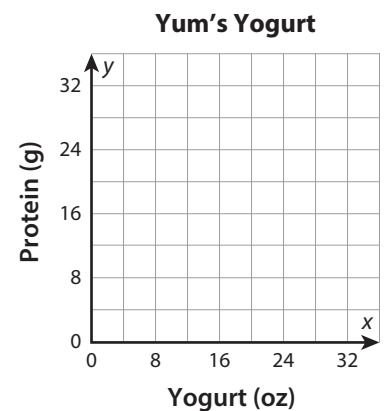
- 8 Enrique has a container of 32 fl oz of orange juice. He is filling glasses with 1 cup of juice. The point on the graph shows the ratio of fluid ounces to cups. Based on this ratio, how many glasses can Enrique fill from the container? Plot a point on the graph to show the number of cups in 32 fl oz. Show your work.



### SOLUTION

- 9 Every 4-oz serving of Yum's Yogurt contains 8 g of protein. Complete the table of equivalent ratios. Then plot points on the graph to represent the ratios.

Yogurt (oz)	Protein (g)
4	
8	
12	
	32





## Practice Graphing a Table of Equivalent Ratios

- Study the Example showing how to graph a table of equivalent ratios. Then solve problems 1–5.

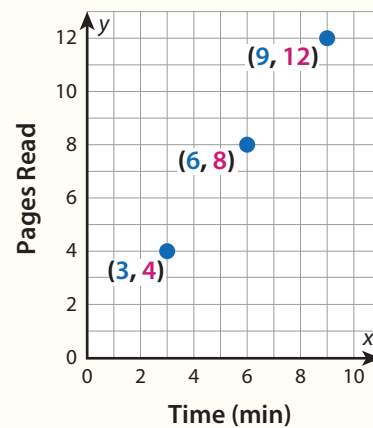
### Example

Jade reads 4 pages every 3 min. Make a table of equivalent ratios to show how many pages Jade can read in 3 min, 6 min, and 9 min. Then graph the equivalent ratios.

Record the ratio 3 to 4 in one row of a table. Find equivalent ratios for 6 min and 9 min by multiplying each number in the ratio 3 : 4 by 2 and by 3.

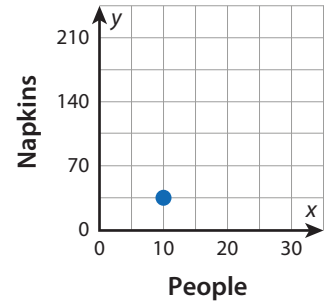
Time (min)	Pages Read
3	4
6	8
9	12

Think of each ratio in the table as an ordered pair  $(x, y)$ . The  $x$ -coordinate is the **time in minutes** and the  $y$ -coordinate is the **number of pages read**.



- How would the graph in the Example change if Jade reads 5 pages every 3 minutes instead of 4 pages every 3 minutes?
- The point  $(7, 8)$  in the coordinate plane represents a ratio. Adela claims that you can find an equivalent ratio by adding the same number to both coordinates of the point. Is Adela correct? Explain.

3 Jordan and Mia are bringing napkins to a back-to-school picnic. They decide to bring 35 napkins for every 10 people who plan to attend. The point on the graph represents this ratio.



a. Plot another point that represents an equivalent ratio. Explain how you found the coordinates of this point.

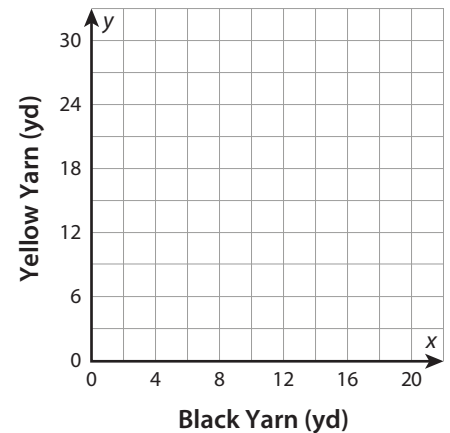
b. What do the coordinates of the point you plotted represent in this situation?

4 Allen is making a scarf for charity. He uses 4 yd of black yarn for every 6 yd of yellow yarn.

a. Complete the table of equivalent ratios.

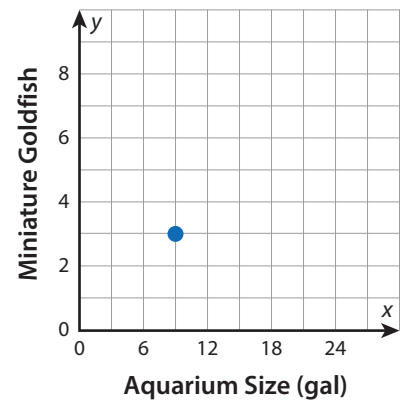
<b>Black Yarn (yd)</b>	2	4	12	
<b>Yellow Yarn (yd)</b>		6		30

b. Plot ordered pairs on the graph to represent the ratios.

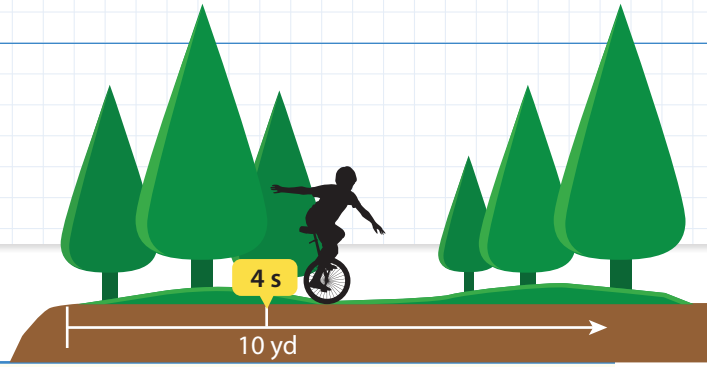


5 An aquarium that holds 9 gal is the correct size for 3 miniature goldfish. The point on the graph represents this ratio relationship. Which ordered pairs represent equivalent ratios that would also be on the graph? Select all that apply.

- A (1, 3)
- B (3, 1)
- C (12, 6)
- D (15, 9)
- E (18, 6)



# Develop Using Equivalent Ratios



► Read and try to solve the problem below.

Ian travels 10 yd on his unicycle every 4 s. Based on this ratio, how many seconds does it take Ian to travel 25 yd on his unicycle?

**TRY IT**



**Math Toolkit** connecting cubes, counters, double number lines, graph paper

**DISCUSS IT**

**Ask:** How does your model show that Ian travels 10 yd every 4 s?

**Share:** I showed this ratio by . . .

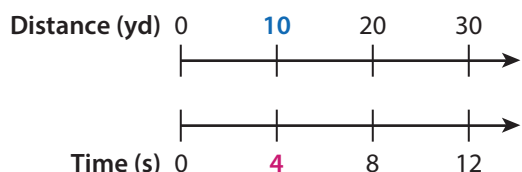
► Explore different ways to use equivalent ratios to solve problems.

Ian travels 10 yd on his unicycle every 4 s. Based on this ratio, how many seconds does it take Ian to travel 25 yd on his unicycle?

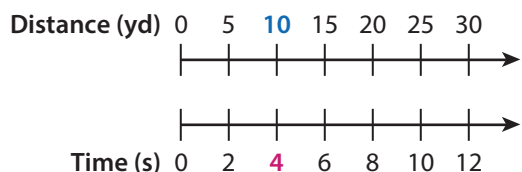
**Model It**

You can use a double number line to solve the problem.

Choose scales to show that Ian travels 10 yd every 4 s.



Add marks halfway between the existing marks to find additional equivalent ratios.



**Model It**

You can use a combination of multiplication and division to solve the problem.

Show the ratios in a table. Think of a way to get from 10 yd to 25 yd by using a combination of multiplication and division.

	$\div 2$	$\times 5$	
Distance (yd)	10	5	25
Time (s)	4	2	?
	$\div 2$	$\times 5$	



## CONNECT IT

► Use the problem from the previous page to help you understand how to use equivalent ratios to solve problems.

- 1 Look at the first **Model It**. How do you know that  $5 : 2$ ,  $15 : 6$ , and  $25 : 10$  are equivalent to the ratio  $10 : 4$ ?
- 2 Can you solve the **Try It** problem by multiplying both quantities in the ratio 10 to 4 by the same whole number? Why or why not?
- 3 Look at the second **Model It**. It shows that the ratio 10 to 4 can be written as the equivalent ratio 5 to 2. Why is this step helpful?
- 4 How many seconds does it take Ian to ride 25 yd on his unicycle? How do you know that your answer is reasonable?
- 5 Why is it sometimes helpful to use a combination of multiplication and division when finding equivalent ratios to solve problems?
- 6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.

## Apply It

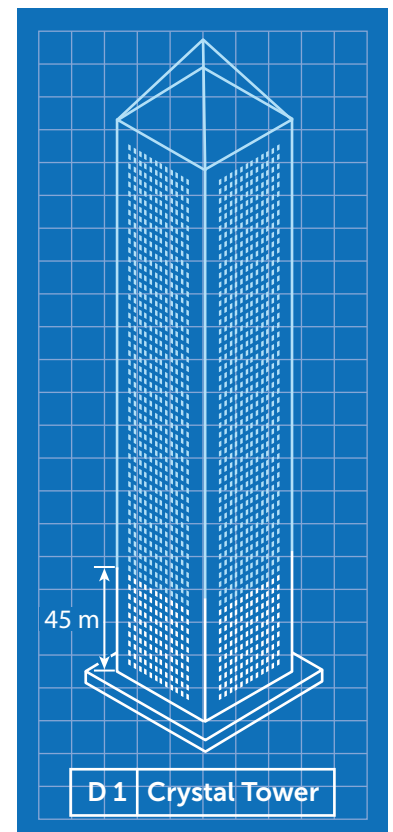
► Use what you learned to solve these problems.

- 7 A caterer typically uses 40 forks for every 25 knives. The caterer estimates that he will use 80 knives today. Use equivalent ratios to estimate the number of forks the caterer will use today. Show your work.

### SOLUTION

---

- 8 Each day, a baker makes the same ratio of blueberry muffins to banana muffins. On Tuesday, she makes 96 blueberry muffins and 72 banana muffins. On Wednesday, she makes 36 blueberry muffins. How many banana muffins does the baker make on Wednesday?
- A 12 banana muffins                      B 27 banana muffins  
C 48 banana muffins                      D 132 banana muffins
- 9 An architect designs a skyscraper with 56 floors. The height of the skyscraper must increase by 45 m for every 10 floors. Based on this ratio, what is the planned height of the skyscraper? Show your work.



### SOLUTION

---

## Practice Using Equivalent Ratios

- Study the Example showing how to use ratios to solve problems. Then solve problems 1–5.

### Example

A company sells shampoo in two sizes of bottles. The ratio of the capacity of a bottle to its cost is the same for both sizes. A large bottle of shampoo contains 32 fl oz and costs \$8. A small bottle contains 12 fl oz. What is the cost of a small bottle of shampoo?

You can use a table of equivalent ratios.

Think of a way to get from 32 to 12 by using a combination of multiplication and division. Then use this combination to find equivalent ratios.

A small bottle of shampoo costs \$3.

Capacity (fl oz)	32	4	12
Cost (\$)	8	1	3

$\div 8$        $\times 3$   
 $\div 8$        $\times 3$

- 1 The company in the Example decides to increase the capacity of its large bottles from 32 fl oz to 40 fl oz. It plans to keep the ratio of capacity to cost the same. How much should the company charge for a bottle that holds 40 fl oz? Show your work.

### SOLUTION

- 2 Which ratio is equivalent to 3 : 18?
- A 6 : 21
  - B 5 : 20
  - C 7 : 42
  - D 12 : 2

### Vocabulary

#### equivalent ratios

two ratios that express the same comparison.

Multiplying both numbers in the ratio  $a : b$  by a nonzero number  $n$  results in the equivalent ratio  $na : nb$ .

- 3 A community garden is surrounded by a fence. The total length of the fence is 3,000 ft. For every 48 ft of fence, there are 4 posts. What is the total number of posts in the fence? Show your work.

**SOLUTION** \_\_\_\_\_

- 4 A company makes first-aid kits in different sizes. The ratio of fabric bandages to plastic bandages in each kit is 3 to 9. A small kit has 16 fabric bandages. How many plastic bandages should a small kit have? Show your work.

**SOLUTION** \_\_\_\_\_

- 5 A bag contains 6 red tiles and 15 yellow tiles. Lilia removes 2 red tiles. How many yellow tiles should she remove so that the ratio of red tiles to yellow tiles in the bag stays equivalent to 6 : 15? Show your work.

**SOLUTION** \_\_\_\_\_



# Refine Finding Equivalent Ratios

► Complete the Example below. Then solve problems 1–9.

## Example

A picture-hanging kit contains 2 short nails for every 8 long nails. There are 28 short nails. How many long nails does the kit contain?

Look at how you could use a table of equivalent ratios.

Short Nails	2	4	6	28
Long Nails	8	16	24	?

In each ratio, the number of long nails is 4 times the number of short nails.

$$? = 4 \times 28$$

**SOLUTION** \_\_\_\_\_

### CONSIDER THIS . . .

How do you know that the ratios 4 : 16 and 6 : 24 are equivalent to 2 : 8?

### PAIR/SHARE

How could you solve this problem a different way to check your answer?

## Apply It

- 1 Nicanor keeps the tickets from all the sporting events he attends. The ratio of baseball tickets to basketball tickets in his collection is 3 : 5. Nicanor has 21 baseball tickets. How many more basketball tickets than baseball tickets does he have? Show your work.

### CONSIDER THIS . . .

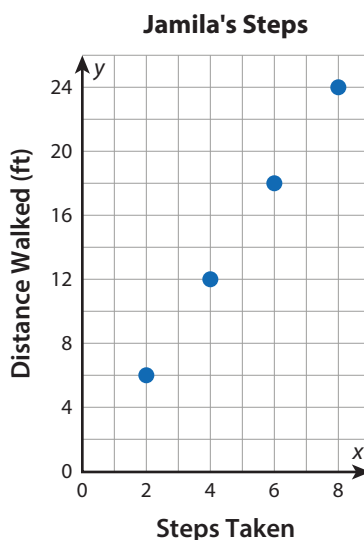
How does the ratio given in the problem show that Nicanor has more basketball tickets than baseball tickets?

**SOLUTION** \_\_\_\_\_

### PAIR/SHARE

How did you use equivalent ratios to help you solve this problem?

- 2 The graph shows the relationship between the number of steps Jamila takes and the distance she walks. Based on the equivalent ratios shown in the graph, how many steps does Jamila need to take to walk 120 ft? Show your work.



**CONSIDER THIS ...**

How can you show that the ordered pairs in the graph represent equivalent ratios?

**PAIR/SHARE**

How does the graph indicate that the number of steps Jamila must take to walk 120 ft is less than 120?

**SOLUTION**

- 3 Carson rides his bike for 30 min each day. He rides a total of 12 mi every 3 days. Based on this information, how many days will it take Carson to ride a total of 80 mi on his bike?

- A 4 days
- B 7 days
- C 10 days
- D 20 days

Galeno chose A as the correct answer. How might he have gotten that answer?

**CONSIDER THIS ...**

How can you find the distance Carson rides in 1 day?

**PAIR/SHARE**

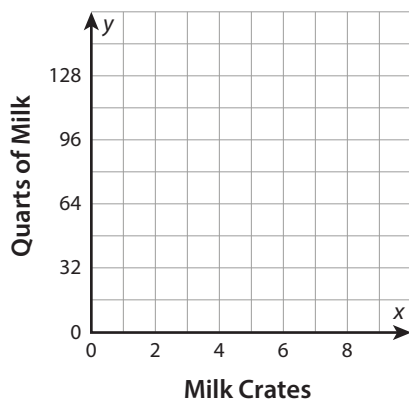
How can you check that your answer is reasonable?

- 4 Mr. Romano is ordering meat for a family reunion. He knows that 80 people plan to attend. He orders 1 lb of chicken for every 5 people and 3 lb of beef for every 10 people. Tell whether each statement is *True* or *False*.

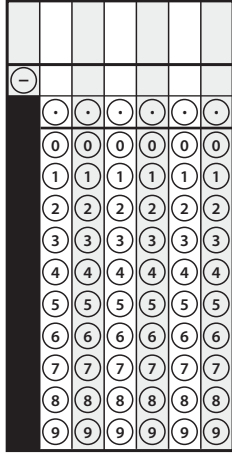
	True	False
a. Mr. Romano orders 48 lb of beef.	<input type="radio"/>	<input type="radio"/>
b. Mr. Romano orders 16 lb of chicken.	<input type="radio"/>	<input type="radio"/>
c. The ratio of pounds of beef to pounds of chicken that Mr. Romano orders is 3 : 2.	<input type="radio"/>	<input type="radio"/>
d. The ratio of pounds of chicken to pounds of beef that Mr. Romano orders is 1 : 3.	<input type="radio"/>	<input type="radio"/>

- 5 Evelyn is making bows from blue and white ribbon. She uses 6 in. of blue ribbon for every 9 in. of white ribbon. Evelyn has 82 in. of blue ribbon and 114 in. of white ribbon. Which color of ribbon will she run out of first? Explain.

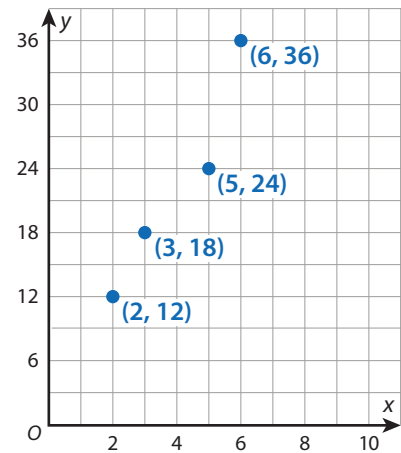
- 6 A dairy farm ships crates of milk to food stores. There are 48 quarts of milk for every 3 crates shipped. Plot points on the graph to show how many quarts of milk there are for shipments of 3, 4, 6, and 9 milk crates. Label each point with its ordered pair.



- 7 Last year, students planted 8 tomato plants and 16 pepper plants in a school garden. This year, the students planted 15 tomato plants. They want to have the same ratio of tomato plants to pepper plants as last year. Pepper plants cost \$4.33 each. What is the cost, in dollars, of the pepper plants for this year's garden?



- 8 The graph shows four ordered pairs that represent ratios. Which ordered pair represents a ratio that is not equivalent to the others?
- A (2, 12)
  - B (3, 18)
  - C (5, 24)
  - D (6, 36)
- 9 **Math Journal** Write a word problem that can be solved by finding an equivalent ratio. Show how to find the answer.



**✓ End of Lesson Checklist**

- INTERACTIVE GLOSSARY** Find the entry for *equivalent ratios*. Add two important things you learned about equivalent ratios in this lesson.
- SELF CHECK** Go back to the Unit 3 Opener and see what you can check off.