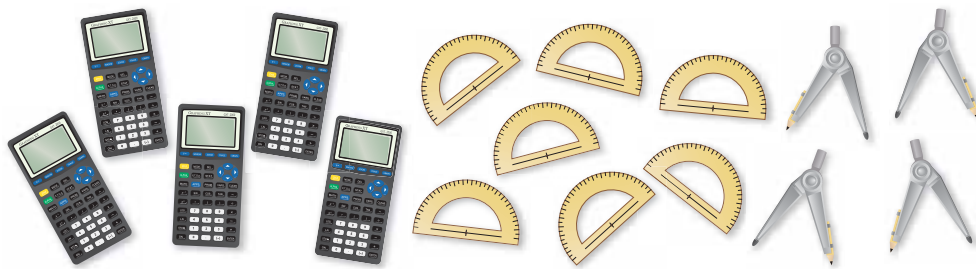# 5.1 Ratios

Essential Question How can you represent a relationship between two quantities?

1 ACTIVITY: Comparing Quantities

Work with a partner. Use the collection of objects to complete each statement.

There are [ ] graphing calculators to [ ] protractors.

There are [ ] protractors to [ ] graphing calculators.

There are [ ] compasses to [ ] protractors.

There are [ ] graphing calculators to [ ] compasses.

There are [ ] protractors to [ ] total objects.

The number of graphing calculators is $\dfrac{[\ ]}{[\ ]}$ of the total number of objects.

2 ACTIVITY: Playing Garbage Basketball

Work with a partner.

- **Take turns shooting a ball or other object into a wastebasket from a reasonable distance.**

- **Organize the numbers of shots you made and shots you missed in a chart.**

Ratios
In this lesson, you will
- understand the concept of a ratio.
- use ratios to describe the relationship between two quantities.

a. Write a statement similar to those in Activity 1 that describes the relationship between the number of shots you made and the number of shots you missed.

b. Write a statement similar to those in Activity 1 that describes the relationship between the number of shots you made and the total number of shots.

c. What fraction of your shots did you make? What fraction did you miss?

3 ACTIVITY: Reading a Diagram

Work with a partner. You mix different amounts of paint to create new colors. Write a statement that describes the relationship between the amounts of paint shown in each diagram.

a. Blue ▮▮▮▮▮

Green ▮▮▮

There are ▭ parts blue for every ▭ parts green.

b. Orange ▮▮

Yellow ▮▮▮

There are ▭ for every ▭ .

c. Red ▮▮▮▮

Blue ▮▮

▭ .

d. White ▯

Purple ▮▮▮▮▮

▭ .

4 ACTIVITY: Describing Relationships

Math Practice

Use a Table or Diagram

What are the quantities in this problem? How does a table or diagram represent the relationship between the quantities?

Work with a partner. Use a table or a diagram to represent the relationship between the two quantities.

a. For every 3 boys standing in a line, there are 4 girls.

b. For each vote Brian received, Sasha received 6 votes.

c. A class counts the number of vehicles that pass by its school from 1:00 to 2:00 P.M. There are 3 times as many cars as trucks.

d. A hand sanitizer contains 5 parts aloe for every 2 parts distilled water.

What Is Your Answer?

5. **IN YOUR OWN WORDS** How can you represent a relationship between two quantities? Give examples to support your explanation.

6. **MODELING** You make 48 pints of pink paint by using 5 pints of red paint for every 3 pints of white paint. Use a diagram to find the number of pints of red paint and white paint in your mixture. Explain.

Practice ➤ Use what you learned about comparing two quantities to complete Exercises 4 and 5 on page 194.
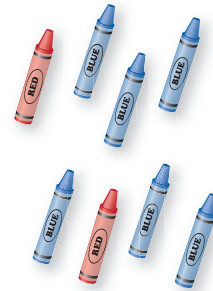
Key Vocabulary 🔊
ratio, *p. 192*

🔑 Key Idea

Ratio

Words A **ratio** is a comparison of two quantities. Ratios can be part-to-part, part-to-whole, or whole-to-part comparisons.

Examples 2 red crayons *to* 6 blue crayons
1 red crayon *for every* 3 blue crayons
3 blue crayons *per* 1 red crayon
3 blue crayons *for each* red crayon
3 blue crayons *out of every* 4 crayons
2 red crayons *out of* 8 crayons

Algebra The ratio of a to b can be written as $a : b$.

EXAMPLE 1 Writing Ratios

You have the coins shown.

a. Write the ratio of pennies to quarters.

6 pennies → 6 to 7 ← 7 quarters

⠿ So, the ratio of pennies to quarters is 6 to 7, or 6 : 7.

b. Write the ratio of quarters to dimes.

7 quarters → 7 to 3 ← 3 dimes

⠿ So, the ratio of quarters to dimes is 7 to 3, or 7 : 3

c. Write the ratio of dimes to the total number of coins.

3 dimes → 3 to 16 ← 16 coins

⠿ So, the ratio of dimes to the total number of coins is 3 to 16, or 3 : 16.

Remember

Part-to-whole relationships compare a part of a whole to the whole. Fractions represent part-to-whole relationships. Part-to-part relationships compare a part of a whole to another part of the whole.

🔴 On Your Own

Now You're Ready
Exercises 6–13

1. In Example 1, write the ratio of dimes to pennies.

2. The circle graph shows the favorite ice-cream toppings of several students. Use ratio language to compare the number of students who favor peanuts to the total number of students.

Favorite Toppings

Peanuts 5
Caramel 1
Fudge 9
Sprinkles 4

🔊 Multi-Language Glossary at BigIdeasMath⟍com
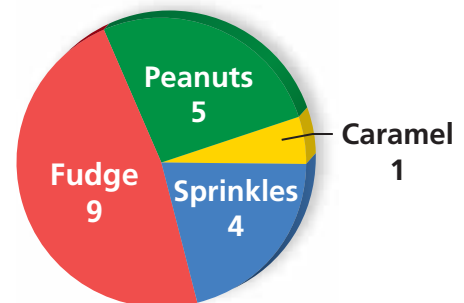
A *tape diagram* is a diagram that looks like a segment of tape. It shows the relationship between two quantities.

EXAMPLE 2 Using a Tape Diagram

The ratio of your monthly allowance to your friend's monthly allowance is 5 : 3. The monthly allowances total $40. How much is each allowance?

To help visualize the problem, express the ratio 5 : 3 using a tape diagram.

You

Your friend

The 8 parts represent $40.
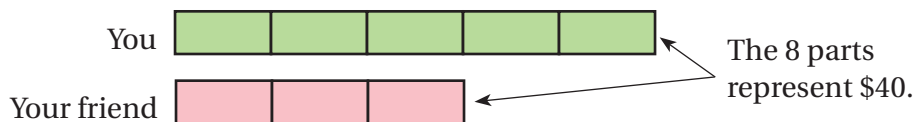
Because there are 8 parts, you know that 1 part represents $40 ÷ 8 = $5.

5 parts represent $5 • 5 = $25.

3 parts represent $5 • 3 = $15.

So, your monthly allowance is $25, and your friend's monthly allowance is $15.

EXAMPLE 3 Using a Tape Diagram

You separate 42 bulbs of garlic into two groups: one for planting and one for cooking. You will plant 3 bulbs for every 4 bulbs that you will use for cooking. Each bulb has about 8 cloves. About how many cloves will you plant?

To help visualize the problem, express the ratio *3 for every 4* using a tape diagram.

Planting

6	6	6

Cooking

6	6	6	6

The 7 parts represent 42 bulbs, so each part represents 42 ÷ 7 = 6 bulbs.
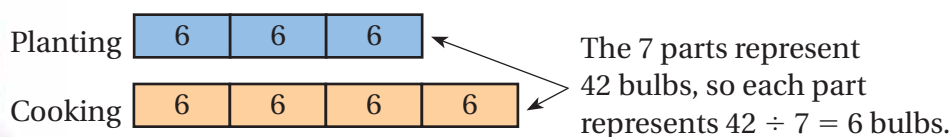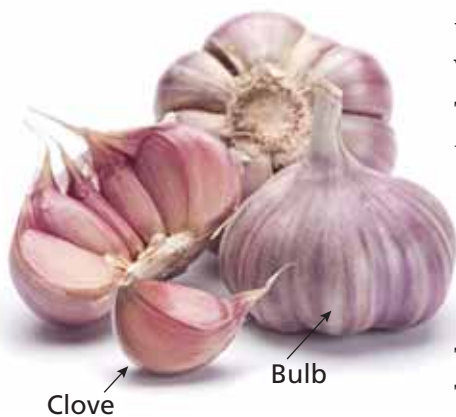
There are 3 • 6 = 18 bulbs for planting and 4 • 6 = 24 bulbs for cooking. The group of 18 bulbs has about 18 • 8 = 144 cloves.

So, you will plant about 144 cloves.

Bulb

Clove

On Your Own

Now You're Ready
Exercises 15 and 16

3. **WHAT IF?** In Example 2, the ratio is 2 to 3. How much is each allowance?

4. **WHAT IF?** In Example 3, you will plant 1 bulb for every 2 bulbs that you will use for cooking. Will you plant more or fewer cloves than originally planned? Explain your reasoning.

Vocabulary and Concept Check

1. **VOCABULARY** The ratio of vowels to consonants in a word is 5 to 7. Are there more vowels or consonants in the word? Explain.

2. **NUMBER SENSE** You are comparing apples to oranges in a fruit bowl. Is the ratio 2 : 3 the same as the ratio 3 : 2? Explain.

3. **WHICH ONE DOESN'T BELONG?** Which ratio does *not* belong with the other three? Explain your reasoning.

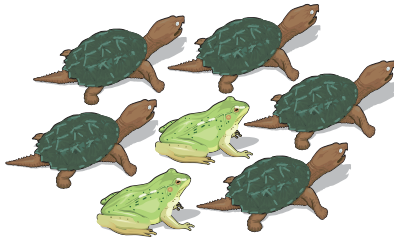| 2 parts to 5 parts | 2 out of every 5 | 2 for each 5 | 2 for every 5 |

Practice and Problem Solving

Use a table or a diagram to represent the relationship between the two quantities.

4. For each lion, there are 7 giraffes.

5. For every 5 seats, there are 4 fans.

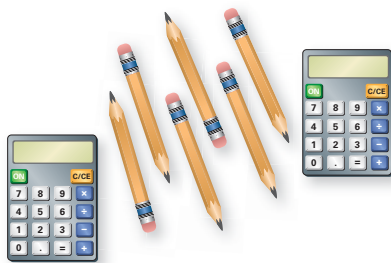**Write the ratio. Explain what the ratio means.**

6. frogs to turtles

7. basketballs to soccer balls

8. calculators : pencils

9. shirts : pants

**Use the table to write the ratio. Explain what the ratio means.**

Movie	Number
Drama	3
Comedy	8
Action	4

10. dramas to movies

11. comedies to movies

12. movies : action

13. movies : dramas

| Topic	Stamps
Birds	7
Celebrity	14
Horses	5
Ships	9

14. **STAMP COLLECTING** The table shows the numbers of stamps in a new stamp collection. Use ratio language to compare the number of celebrity stamps to the total number of stamps.

You and a friend tutor for a total of 12 hours. Use the tape diagram to find how many hours you tutor.

2 **15.**   You [| |]   **16.**   You [|]

Friend [   ]   Friend [| | |]
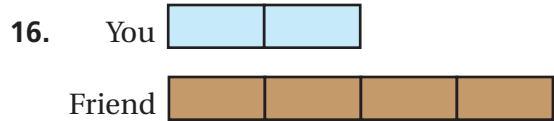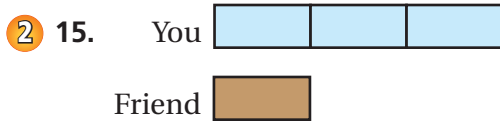
17. REASONING Twelve of the 28 students in a class have a dog. What is the ratio of students who have a dog to students who do not?

18. GEOGRAPHY In the continental United States, the ratio of states that border an ocean to states that do not border an ocean is 7 : 9. How many of the states border an ocean?
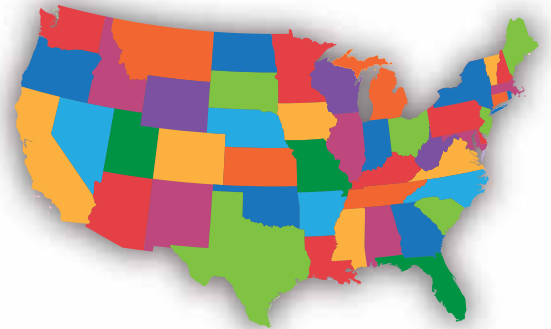
19. CHECKERS During a checkers game, there are 16 pieces left. The ratio of black to red is 3 : 5. How many black pieces are on the board? Explain how you found your answer.

20. SCHOOL PLAY There are 48 students in a school play. The ratio of boys to girls is 5 : 7. How many more girls than boys are in the play? Explain how you found your answer.

21. GEOMETRY Use the blue and green rectangles.

   a. Find the ratio of the length of the blue rectangle to the length of the green rectangle. Repeat this for width, perimeter, and area.

   2 ft   3 ft   4 ft   6 ft
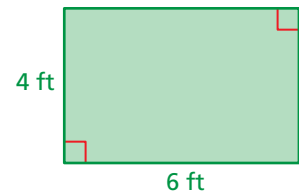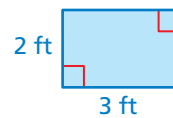
   b. Compare and contrast your ratios in part (a).

22. PERIMETER The ratio of the side lengths of a triangle is 2 : 3 : 4. The shortest side is 15 inches. What is the perimeter? Explain.

23. PRECISION You mix soda water, fruit punch concentrate, and ginger ale in the ratio of 1 : 2 : 5 to make fruit punch. How many pints of each ingredient should you use to make 4 gallons of fruit punch? Is your answer reasonable? Explain.

24. Reasoning There are 12 boys and 10 girls in your gym class. If 6 boys joined the class, how many girls would need to join for the ratio of boys to girls to remain the same? Justify your answer.

Fair Game Review *What you learned in previous grades & lessons*

Divide. *(Section 2.6)*

25. $13.8 \div 3$ **26.** $16.45 \div 5$ **27.** $53.13 \div 21$ **28.** $19.214 \div 13$

29. MULTIPLE CHOICE What is the value of the expression $x \div y$ when $x = 30$ and $y = 18$? *(Section 3.1)*

   Ⓐ $\dfrac{3}{5}$ **Ⓑ** $1\dfrac{2}{3}$ **Ⓒ** 12 **Ⓓ** 48