Operations with Fractions

Indiana Academic Standards

6.1.6 Solve problems involving addition, subtraction, multiplication and division of positive fractions and decimals and explain why a particular operation was used for a given situation.

Key Vocabulary

like fractions (p. 256)

unlike fractions (p. 263)

Real-World Link

Animals The state animal of New York is the beaver, whose average length is $3\frac{1}{2}$ feet long. The beaver's tail averages $1\frac{3}{5}$ feet long.

FOLDABLES
Study Organizer

Operations with Fractions Make this Foldable to help you organize your notes. Begin with two sheets of plain $11'' \times 17''$ paper, four index cards, and glue.
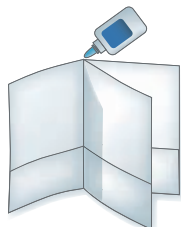
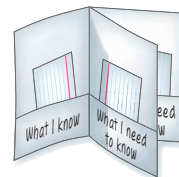**1** **Fold** one sheet in half widthwise.

2 **Open** and fold the bottom to form a pocket. Glue edges.

3 **Repeat** steps 1 and 2. Glue the back of one piece to the front of the other to form a booklet.

4 **Label** each left-hand pocket *What I Know* and each right-hand pocket *What I Need to Know.* Place an index card in each pocket.

GET READY for Chapter 5

Diagnose Readiness You have two options for checking Prerequisite Skills.

Option 1

Take the Quick Quiz below. Refer to the Quick Review for help.

QUICK Quiz

Estimate using rounding.
(Prior Grade)

1. $1.2 + 6.6$
2. $9.6 - 2.3$
3. $8.25 - 4.8$
4. $5.85 + 7.1$

5. **MONEY** Braden spent $17.88 on a hat and $4.22 on lunch. About how much did he spend altogether?

Write each fraction in simplest form. (Lesson 4-2)

6. $\dfrac{3}{18}$
7. $\dfrac{21}{28}$
8. $\dfrac{16}{40}$
9. $\dfrac{6}{38}$

10. **HOMEWORK** Sandra finished 21 out of 39 problems. Write the fraction, in simplest form, of homework that she completed.

Write each improper fraction as a mixed number. (Lesson 4-2)

11. $\dfrac{11}{10}$
12. $\dfrac{14}{5}$
13. $\dfrac{7}{5}$
14. $\dfrac{15}{9}$

QUICK Review

Example 1
Estimate 8.74 − 2.15 using rounding.
Round 8.74 to 9 and 2.15 to 2.
$9 - 2 = 7$
So, $8.74 - 2.15$ is *about* 7.

Example 2
Write $\dfrac{24}{36}$ in simplest form.

$$\overset{\div 12}{\dfrac{24}{36}} = \dfrac{2}{3} \quad \underset{\div 12}{}$$

Divide the numerator and denominator by the GCF, 12.

Since the GCF of 2 and 3 is 1, the fraction $\dfrac{2}{3}$ is in simplest form.

Example 3
Write $\dfrac{19}{7}$ as a mixed number.

Divide 19 by 7.

$$\begin{array}{r} 2\frac{5}{7} \\ 7\overline{)19} \\ -14 \\ \hline 5 \end{array}$$

Use the remainder as the numerator of the fraction.

So, $\dfrac{19}{7} = 2\dfrac{5}{7}$.

Math Lab
Rounding Fractions

In Lesson 3-3, you learned to round decimals. You can use a similar method to round fractions.

ACTIVITY

Draw and shade a model to represent each fraction. Then use the model to round each fraction to the nearest half.

1 $\frac{4}{20}$

Shade 4 out of 20.

Very few sections are shaded. So, $\frac{4}{20}$ rounds to 0.

2 $\frac{4}{10}$

Shade 4 out of 10.

About one half of the sections are shaded. So, $\frac{4}{10}$ rounds to $\frac{1}{2}$.

3 $\frac{4}{5}$

Shade 4 out of 5.

Almost all of the sections are shaded. So, $\frac{4}{5}$ rounds to 1.

CHECK Your Progress

Draw and shade a model to represent each fraction. Then use the model to round each fraction to the nearest half.

a. $\frac{13}{20}$ b. $\frac{7}{8}$ c. $\frac{9}{10}$ d. $\frac{1}{5}$ e. $\frac{11}{15}$

f. $\frac{2}{25}$ g. $\frac{6}{10}$ h. $\frac{17}{20}$ i. $\frac{1}{8}$ j. $\frac{7}{16}$

ANALYZE THE RESULTS

1. Sort the fractions in Exercises a–j into three groups: those that round to 0, those that round to $\frac{1}{2}$, and those that round to 1.

2. **MAKE A CONJECTURE** Compare the numerators and denominators of the fractions in each group. Explain how to round any fraction to the nearest half without using a model.

3. Test your conjecture by repeating the activity and Exercise 1 using the fractions $\frac{3}{5}$, $\frac{3}{17}$, $\frac{16}{20}$, $\frac{2}{13}$, $\frac{5}{24}$, $\frac{7}{15}$, $\frac{7}{9}$, and $\frac{9}{11}$.

Rounding Fractions and Mixed Numbers

MINI Lab

Using a ruler, measure the thickness of your textbook.

1. What is the thickness of your book?

2. Looking at the ruler, is the thickness of the book at the right closer to 1 inch, $1\frac{1}{2}$ inches, or 2 inches?

STEP 1 Pick several objects from your classroom. Measure the lengths of the objects to the nearest eighth of an inch.

STEP 2 Sort the different measurements into different categories: those that round up to the next greater whole number, those that round to a half inch, and those that round down to the smaller whole number.

3. Compare the numerators and denominators of the fractions in each group. How do they compare?

4. Write a rule about how to round to the nearest half inch.

It is often helpful to be able to round fractions and mixed numbers to the nearest half in real-world situations. To round fractions and mixed numbers to the nearest half, you can use the following guidelines.

Rounding to the Nearest Half　　　Key Concept

Round Up

If the numerator is almost as large as the denominator, round the number up to the next whole number.

Example

$\frac{7}{8}$ rounds to 1.

7 is almost as large as 8.

Round to $\frac{1}{2}$

If the numerator is about half of the denominator, round the fraction to $\frac{1}{2}$.

Example

$2\frac{3}{8}$ rounds to $2\frac{1}{2}$.

3 is about half of 8.

Round Down

If the numerator is much smaller than the denominator, round the number down to the previous whole number.

Example
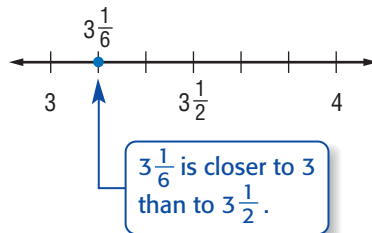
$\frac{1}{8}$ rounds to 0.

1 is much smaller than 8.

EXAMPLE **Round to the Nearest Half**

1 Round $3\frac{1}{6}$ to the nearest half.

$3\frac{1}{6}$ is closer to 3 than to $3\frac{1}{2}$.

The numerator of $\frac{1}{6}$ is much smaller than the denominator. So, $3\frac{1}{6}$ rounds to 3.

CHECK Your Progress

Round each number to the nearest half.

a. $8\frac{1}{12}$ b. $2\frac{9}{10}$ c. $\frac{2}{9}$

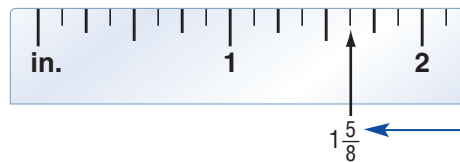d. $\frac{5}{12}$ e. $1\frac{2}{5}$ f. $4\frac{3}{7}$

EXAMPLE **Measure to the Nearest Half**

2 Find the length of the leaf to the nearest half inch.

Since 5 is about half of 8, $1\frac{5}{8}$ rounds to $1\frac{1}{2}$.

$1\frac{5}{8}$

To the nearest half inch, the leaf is $1\frac{1}{2}$ inches.

CHECK Your Progress

g. Find the width of the bracelet to the nearest half inch.
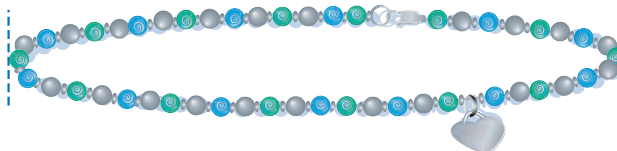
Sometimes you should round a number down when it is better for a measure to be too small than too large. Other times you should round up despite what the rule says.

Real-World EXAMPLE

3 **ANIMALS** A pet store sells pet collars in different lengths. Jonathan measured the distance around his puppy's neck to be $11\frac{1}{4}$ inches. Should he buy the 11-inch collar or the 12-inch collar?

Even though $11\frac{1}{4}$ rounds down to 11, the puppy's neck is too large for the 11-inch collar. Jonathan should buy the 12-inch collar.

CHECK Your Progress

h. **FURNITURE** The Turners are buying a sofa for their basement. The width of their basement door is $29\frac{3}{4}$ inches. Should they round $29\frac{3}{4}$ inches up or down to guarantee that the sofa fits through the door? Explain your reasoning.

CHECK Your Understanding

Example 1
(p. 250)

Round each number to the nearest half.

1. $\frac{7}{8}$ 2. $3\frac{1}{10}$ 3. $\frac{3}{8}$ 4. $6\frac{2}{3}$ 5. $\frac{1}{5}$

Example 2
(p. 250)

Find the length of each item to the nearest half inch.

6.   7.
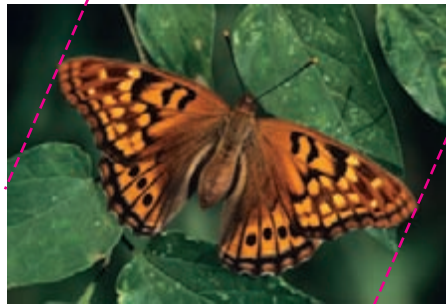
Example 3
(p. 251)

8. **DRAWINGS** To carry her drawings home from school this year, Sara wants to make her drawings small enough to fit into an $8\frac{1}{2}$-inch-wide binder pocket. When deciding on the width of the drawings she will make, should she round $8\frac{1}{2}$ inches up or down? Explain your reasoning.

9. **GARDENING** Based on the area of his flowerbed, a gardener calculates that he needs to dilute $4\frac{3}{8}$ gallons of fertilizer with water. Should he round $4\frac{3}{8}$ gallons up or down when deciding on the amount of fertilizer to purchase? Explain your reasoning.

Practice and Problem Solving

Round each number to the nearest half.

10. $\dfrac{5}{6}$ 11. $2\dfrac{4}{5}$ 12. $4\dfrac{2}{9}$ 13. $9\dfrac{1}{6}$ 14. $3\dfrac{2}{9}$

15. $3\dfrac{1}{12}$ 16. $\dfrac{1}{3}$ 17. $5\dfrac{3}{10}$ 18. $\dfrac{7}{12}$ 19. $3\dfrac{2}{3}$

Find the length of each item to the nearest half inch.

20.

21.

22.

23.

24. **DECORATING** The Santiagos are buying blinds to fit in a window opening that is $24\dfrac{3}{4}$ inches wide. Should they round $24\dfrac{3}{4}$ inches up or down when deciding on the size of blinds to purchase? Explain your reasoning.
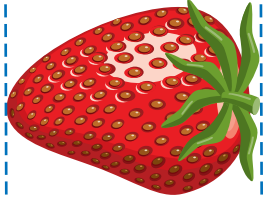
25. **PACKAGES** Martin is mailing a gift that is $14\dfrac{3}{8}$ inches tall. He can choose from several shipping boxes. Should he round $14\dfrac{3}{8}$ inches up or down when selecting a shipping box? Explain your reasoning.

Round each number to the nearest half.

26. $\dfrac{13}{16}$ 27. $6\dfrac{5}{16}$ 28. $9\dfrac{7}{24}$ 29. $4\dfrac{19}{32}$

30. **SHELVES** Your bedroom has an $8\dfrac{1}{4}$-foot ceiling. To the nearest half foot, what is the tallest bookcase that can fit in your bedroom?

31. **CRAFTS** Marina is making birthday cards. She is using envelopes that are $6\dfrac{3}{4}$ inches by $4\dfrac{5}{8}$ inches. To the nearest half inch, how large can she make her cards?

Use rounding to order each set of numbers from least to greatest.

32. $\dfrac{7}{8}, \dfrac{2}{11}, \dfrac{4}{7}$ 33. $3\dfrac{5}{9}, 3\dfrac{3}{14}, 3\dfrac{6}{7}$ 34. $7\dfrac{6}{11}, 7\dfrac{9}{10}, 7\dfrac{1}{7}$

35. **ANALYZE GRAPHS** Several students were asked to name their favorite free-time activity. Are more than half the students represented by any one category? Explain your reasoning.

Free-Time Activities

CHALLENGE Round each number to the nearest fourth. Explain your reasoning.

36. $\frac{3}{16}$

37. $\frac{79}{100}$

38. $\frac{21}{40}$

39. Which One Doesn't Belong? Identify the number that does not belong with the other three. Explain your reasoning.

| $3\frac{7}{8}$ | $4\frac{4}{5}$ | $4\frac{2}{7}$ | $3\frac{8}{9}$ |

40. OPEN ENDED Select three mixed numbers with different denominators that each round up to $7\frac{1}{2}$.

41. WRITING IN MATH Explain how to decide when to round a fraction to 0, $\frac{1}{2}$, or 1 when rounding to the nearest half.

ISTEP+ PRACTICE Preparation for 6.1.6

42. What is the length of the worm to the nearest half inch?

A $1\frac{1}{5}$

B 2

C $2\frac{1}{2}$

D 3

43. The pages in Brooke's scrapbook are $9\frac{3}{4}$ inches by $10\frac{3}{8}$ inches. To the nearest half inch, what is the largest photograph she can place on a page?

F 9 inches by 10 inches

G $9\frac{1}{2}$ inches by 10 inches

H 9 inches by $10\frac{1}{2}$ inches

J $9\frac{1}{2}$ inches by $10\frac{1}{2}$ inches

Spiral Review

44. Graph and label each point in the table at the right on a coordinate plane. (Lesson 4-9)

Write each fraction or mixed number as a decimal. (Lesson 4-8)

45. $\frac{1}{8}$

46. $4\frac{4}{5}$

47. $\frac{2}{5}$

48. $2\frac{3}{16}$

Point	x	y
A	3	1
B	2.5	4
C	4.25	0
D	1	2

49. ANTARCTICA The average depth of ice covering Antarctica is about 1.12 miles. Write this depth as a mixed number in simplest form. (Lesson 4-7)

GET READY for the Next Lesson

50. PREREQUISITE SKILL Six friends will split the cost of 2 large pizzas. If each pizza costs $14.99, is $4, $5, or $6 a reasonable answer for the amount that each friend will pay? (Lesson 3-10)

MAIN IDEA: Solve problems by acting them out.

P.S.I. TEAM +

e-Mail: ACT IT OUT

BETHANY: Tonya, Liseli, Meghan, and I want to ride the new ride Teradactyl at the amusement park. Each car on the ride has two rows with two seats in each row.

YOUR MISSION: Act it out to find how many different ways the four friends can sit in a car on the ride so that Tonya and Meghan sit next to each other.

Understand	You know that each car on the ride has two rows of seats. There are two seats in each row. Tonya and Meghan want to sit next to each other.
Plan	You can arrange student desks to model the amusement park ride. Place four desks in two rows with two desks in each row. Have four students act out possible arrangements and record each one. Use B for Bethany, T for Tonya, L for Liseli, and M for Meghan.
Solve	Meghan and Tonya can either sit in the front row or the back row. There are 8 possible ways for the friends to sit in the car on the ride.
Check	In each row, there are four ways for the friends to sit. So, having 8 possible ways makes sense.

Analyze The Strategy

1. Explain how this strategy could help determine the reasonableness of your answer after the calculations were completed.

2. **WRITING IN MATH** Write a problem that could be solved by using the *act it out* strategy. Then explain how you would act it out.

Mixed Problem Solving

Use the *act it out* strategy to solve Exercises 3–5.

3. **RESTAURANTS** A restaurant serves a chicken entrée and a fish entrée. Each entrée comes with a choice of coffee, tea, lemonade, or water. How many entrée-beverage choices are possible? List them.

4. **RUNNING** Mike, Juliana, Tyrone, and Elisa are entered in a 4-person relay race. In how many orders can they run the relay, if Mike must run last? List them.

5. **TEAMS** Twenty-four students will be divided into four equal-size teams. Each student will count off, beginning with the number 1 as the first team. If Nate is the eleventh student to count off, to which team number will he be assigned?

Use any strategy to solve Exercises 6–14. Some strategies are shown below.

PROBLEM-SOLVING STRATEGIES
- Make a table.
- Act it out.
- Make an organized list.

6. **SEATING** Six students are sitting at a lunch table. Two more students arrive, and at the same time three students leave. How many students are at the table now?

7. **MONEY** Tetuso bought a clock radio for $9 less than the regular price. If he paid $32, what was the regular price?

8. **TESTS** A list of test scores is shown.

English Test Scores						
68	77	99	86	73	75	100
86	70	97	93	80	91	72
85	98	79	77	65	89	71

How many more students scored 71 to 80 than 91 to 100?

9. **INTERNET** Cesar needs to visit three Web sites for a homework assignment. In how many orders can he visit the Web sites?

10. **SCHOOL** The birth months of the students in Miss Miller's geography class are shown below. How many more students were born in June than in August?

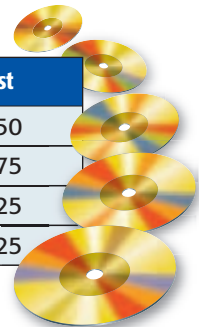| Birth Months		
June	July	April
March	July	June
October	May	August
June	April	October
May	October	April
September	December	January

11. **ANIMALS** Corey has one cat and one hamster. His cat weighs 9.75 pounds and his hamster weighs 1.8 pounds. About how many times more does Corey's cat weigh than his hamster?

12. **PATTERNS** What number is missing in the pattern below?

…, 234, 345, ■, 567, …

13. **DVDs** The table shows the cost of DVD rentals at a video store. Darren purchases a 3-night rental and gets a new release rental for half price. How much money will he have left over if he had $20 to spend originally?

DVD Rentals

Type of Rental	Cost
New Release	$4.50
1-Night	$3.75
2-Night	$4.25
3-Night	$5.25

14. **SCHOOL** Every 8 minutes, Daniela can study twelve Spanish vocabulary words. How many Spanish vocabulary words can she study in 1 hour and 20 minutes?

Adding and Subtracting Fractions with Like Denominators

▷ **MINI Lab**

You can use grid paper to model adding fractions such as $\frac{4}{18}$ and $\frac{3}{18}$.

STEP 1 On grid paper, draw a rectangle like the one shown. Since the grid has 18 squares, each square represents $\frac{1}{18}$.

STEP 2 With a marker, color four squares to represent $\frac{4}{18}$. With a different marker, color three more squares to represent $\frac{3}{18}$.
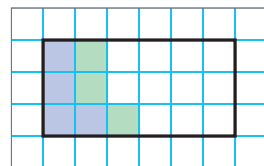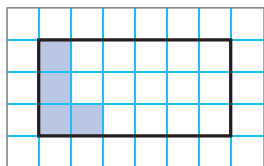
STEP 3 Seven of the 18 squares are colored. So, the sum of $\frac{4}{18}$ and $\frac{3}{18}$ is $\frac{7}{18}$.

Find each sum using grid paper.

1. $\frac{4}{12} + \frac{3}{12}$ **2.** $\frac{1}{6} + \frac{1}{6}$ **3.** $\frac{3}{10} + \frac{5}{10}$

4. What patterns do you notice with the numerators?

5. What patterns do you notice with the denominators?

6. Explain how you could find the sum $\frac{3}{8} + \frac{1}{8}$ without using grid paper.

Fractions with the same denominator are called **like fractions**. When you add and subtract like fractions, the denominator names the units being added or subtracted.

4 eighteenths	plus	3 eighteenths	equals	7 eighteenths
$\frac{4}{18}$	$+$	$\frac{3}{18}$	$=$	$\frac{7}{18}$

Add Like Fractions

Key Concept

Words To add fractions with the same denominators, add the numerators. Use the same denominator in the sum. For example, *2 fifths plus 1 fifth equals 3 fifths.*

Examples

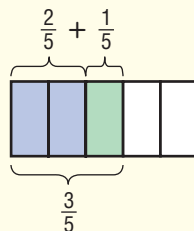| Model	Numbers

$$\frac{2}{5} + \frac{1}{5}$$

$$\frac{2}{5} + \frac{1}{5} = \frac{2+1}{5}$$

$$= \frac{3}{5}$$

$$\frac{3}{5}$$

EXAMPLE **Add Like Fractions**

1 Find the sum of $\frac{4}{5}$ and $\frac{3}{5}$.

Estimate $1 + \frac{1}{2} = 1\frac{1}{2}$

$$\frac{4}{5} + \frac{3}{5} = \frac{4+3}{5}$$ Add the numerators.

$$= \frac{7}{5}$$ Simplify.

$$= 1\frac{2}{5}$$ Write as a mixed number.

$\frac{4}{5} + \frac{3}{5}$

$1\frac{2}{5}$
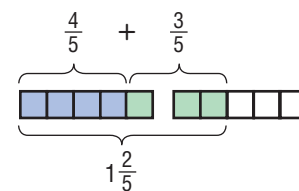
Check for Reasonableness Compare $1\frac{2}{5}$ to the estimate. $1\frac{2}{5} \approx 1\frac{1}{2}$ ✔

✓ CHECK Your Progress

Add. Write in simplest form.

a. $\frac{1}{6} + \frac{5}{6}$ b. $\frac{4}{7} + \frac{6}{7}$ c. $\frac{1}{9} + \frac{5}{9}$

Review Vocabulary

simplest form the form of a fraction when the GCF of the numerator and denominator is 1;

Example: $\frac{3}{4}$ (Lesson 4-2)

The rule for subtracting fractions is similar to the rule for adding fractions.

Subtract Like Fractions

Key Concept

Words To subtract fractions with the same denominators, subtract the numerators. Use the same denominator in the difference. For example, *3 fifths minus 1 fifth equals 2 fifths.*

Examples

Model	Numbers

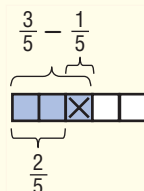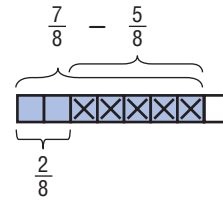$$\frac{3}{5} - \frac{1}{5}$$

$$\frac{3}{5} - \frac{1}{5} = \frac{3-1}{5}$$

$$= \frac{2}{5}$$

$$\frac{2}{5}$$

EXAMPLE **Subtract Like Fractions**

2 Find $\frac{7}{8} - \frac{5}{8}$. Write in simplest form.

$$\frac{7}{8} - \frac{5}{8} = \frac{7-5}{8} \quad \text{Subtract the numerators.}$$

$$= \frac{2}{8} \text{ or } \frac{1}{4} \quad \text{Simplify.}$$

Check *7 eighths minus 5 eighths equals 2 eighths.* ✔

$\frac{7}{8} - \frac{5}{8}$

$\frac{2}{8}$

CHECK Your Progress Subtract. Write in simplest form.

d. $\frac{5}{9} - \frac{2}{9}$　　　　e. $\frac{11}{12} - \frac{5}{12}$　　　　f. $\frac{7}{10} - \frac{3}{10}$

Real-World EXAMPLE

3 **POPULATION** About $\frac{6}{100}$ of the population of the United States lives in Florida. Another $\frac{4}{100}$ lives in Ohio. How much more of the U.S. population lives in Florida than in Ohio?

$$\frac{6}{100} - \frac{4}{100} = \frac{6-4}{100} \quad \text{Subtract the numerators.}$$

$$= \frac{2}{100} \text{ or } \frac{1}{50} \quad \text{Simplify.}$$

About $\frac{1}{50}$ more of the U.S. population lives in Florida than in Ohio.

Check *6 hundredths minus 4 hundredths equals 2 hundredths.* ✔

Real-World Link . . . .
Ohio is the seventh largest state in the United States ranked by population. In 2006, its estimated population was 11,478,006.

Source: U.S. Census Bureau

CHECK Your Progress

g. **JUICE** Two-fifths quart of pineapple juice was added to a bowl containing $\frac{3}{5}$ quart of orange juice. How many total quarts of pineapple juice and orange juice are in the bowl?

CHECK Your Understanding

Examples 1, 2
(pp. 257–258)

Add or subtract. Write in simplest form.

1. $\frac{3}{5} + \frac{1}{5}$　　　　2. $\frac{2}{7} + \frac{1}{7}$　　　　3. $\frac{3}{4} + \frac{3}{4}$

4. $\frac{3}{8} - \frac{1}{8}$　　　　5. $\frac{4}{5} - \frac{1}{5}$　　　　6. $\frac{6}{7} - \frac{2}{7}$

Example 3
(p. 258)

7. **PRESIDENTS** As of 2007, $\frac{8}{42}$ of the U.S. presidents were born in Virginia and $\frac{7}{42}$ were born in Ohio. What fraction of the U.S. presidents were born in either Virginia or Ohio? Write in simplest form.

Add or subtract. Write in simplest form.

8. $\dfrac{4}{5} + \dfrac{3}{5}$

9. $\dfrac{5}{7} + \dfrac{6}{7}$

10. $\dfrac{3}{8} + \dfrac{7}{8}$

11. $\dfrac{1}{9} + \dfrac{5}{9}$

12. $\dfrac{5}{6} + \dfrac{5}{6}$

13. $\dfrac{15}{16} + \dfrac{7}{16}$

14. $\dfrac{9}{10} - \dfrac{3}{10}$

15. $\dfrac{5}{8} - \dfrac{3}{8}$

16. $\dfrac{5}{14} - \dfrac{1}{14}$

17. $\dfrac{5}{9} - \dfrac{2}{9}$

18. $\dfrac{7}{12} - \dfrac{2}{12}$

19. $\dfrac{15}{18} - \dfrac{13}{18}$

20. **GRADES** In Mr. Navarro's first period class, $\dfrac{17}{28}$ of the students got an A on their math test. In his second period class, $\dfrac{11}{28}$ of the students got an A. How many more of the students got an A in Mr. Navarro's first period class than his second period class?

21. **COOKING** A recipe for Michigan blueberry pancakes calls for $\dfrac{3}{4}$ cup flour, $\dfrac{1}{4}$ milk, and $\dfrac{1}{4}$ cup blueberries. How much more flour is needed than milk?

ANALYZE TABLES For Exercises 22 and 23, use the table and the information below.

The table shows the Instant Messenger abbreviations that students use the most at Hillside Middle School.

Instant Messenger Abbreviations	
L8R (Later)	$\dfrac{48}{100}$
LOL (Laughing out loud)	$\dfrac{26}{100}$
BRB (Be right back)	$\dfrac{19}{100}$
CUL8R (See you later)	$\dfrac{7}{100}$

22. What fraction of these students uses LOL or CUL8R when using Instant Messenger?

23. What fraction of these students uses L8R or BRB when using Instant Messenger?

Use the order of operations to add or subtract. Write in simplest form.

24. $\dfrac{4}{5} + \dfrac{1}{5} + \dfrac{3}{5}$

25. $\dfrac{7}{8} + \dfrac{5}{8} - \dfrac{1}{8}$

26. $\dfrac{13}{14} - \dfrac{5}{14} + \dfrac{6}{14}$

Write an addition or subtraction expression for each model. Then add or subtract.

27.

28.

29. **ANALYZE GRAPHS** The graph shows the location of volcanic eruptions in 2006. What fraction represents the volcanic eruptions for both North and South America? How much larger is the section for Asia and South Pacific than for Europe?

Worldwide Volcano Eruptions, 2006

North America $\dfrac{1}{10}$
South America $\dfrac{2}{10}$
Asia and South Pacific $\dfrac{6}{10}$
Europe $\dfrac{1}{10}$
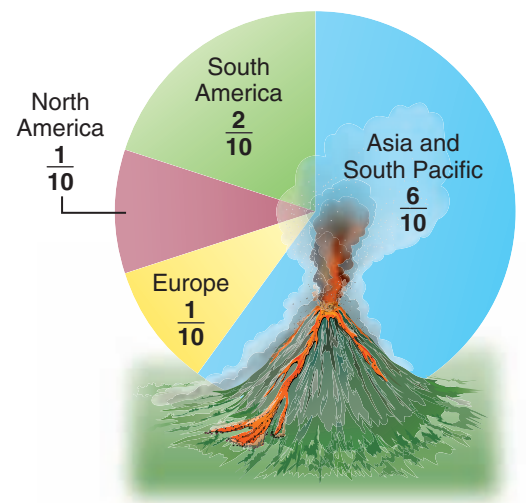
30. **MEASUREMENT** How much longer than $\dfrac{5}{16}$ inch is $\dfrac{13}{16}$ inch?

Draw a model for each expression. Then add or subtract.

31. $\frac{3}{11} + \frac{6}{11}$ **32.** $\frac{3}{4} - \frac{1}{4}$ **33.** $\frac{4}{9} + \frac{7}{9}$

34. OPEN ENDED Select two like fractions with a difference of $\frac{1}{3}$ and with denominators that are *not* 3. Justify your selection.

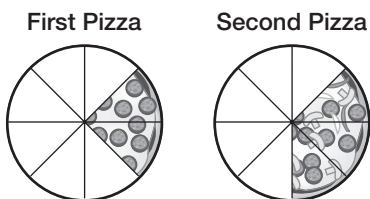**35. CHALLENGE** Simplify the following expression.

$$\frac{14}{15} + \frac{13}{15} - \frac{12}{15} + \frac{11}{15} - \frac{10}{15} + \cdots - \frac{4}{15} + \frac{3}{15} - \frac{2}{15} + \frac{1}{15}$$

36. WRITING IN MATH Write a simple rule for adding and subtracting like fractions.

ISTEP+ PRACTICE 6.1.6

37. A group of friends bought two large pizzas and ate only part of each pizza. The pictures show how much of the pizzas were left.

First Pizza   Second Pizza

How many pizzas did they eat?

A $\frac{3}{8}$ **B** $\frac{5}{8}$ **C** $1\frac{1}{4}$ **D** $1\frac{3}{8}$

38. At a school carnival, homemade pies were cut into 8 equal-sized pieces. Eric sold 13 pieces, Elena sold 7 pieces, and Tanya sold 10 pieces. Which expression can be used to find the total number of pies sold by Eric, Elena, and Tanya?

F $13 + 7 + 10$

G $8(13 + 7 + 10)$

H $\frac{13}{8} \times \frac{7}{8} \times \frac{10}{8}$

J $\frac{13}{8} + \frac{7}{8} + \frac{10}{8}$

Spiral Review

39. SCHOOL Three students need to give their presentations in science class. How many different ways can the teacher arrange the presentations? (Lesson 5-2)

Round each number to the nearest half. (Lesson 5-1)

40. $3\frac{2}{5}$ **41.** $\frac{1}{12}$ **42.** $6\frac{4}{7}$

43. GAMES Find the area of a rectangular game board that is 25 inches long and 11 inches wide. (Lesson 1-9)

GET READY for the Next Lesson

PREREQUISITE SKILL Find the LCD for each pair of fractions. (Lesson 4-5)

44. $\frac{3}{4}$ and $\frac{5}{8}$ **45.** $\frac{2}{3}$ and $\frac{1}{2}$ **46.** $\frac{3}{10}$ and $\frac{3}{4}$ **47.** $\frac{4}{5}$ and $\frac{2}{9}$

Math Lab
Unlike Denominators

In this lab, you will use fraction strips to add and subtract fractions with *unlike* denominators.

ACTIVITY

1 Use fraction strips to find $\frac{1}{2} + \frac{1}{5}$.

STEP 1 Model each fraction.

$\frac{1}{2}$

$\frac{1}{5}$

STEP 2 To add, line up the end of the shaded part of the first strip with the beginning of the second strip.

$\frac{1}{2}$
$+ \frac{1}{5}$

STEP 3 Test different fraction strips below the model, lining up each with the beginning of the first strip. Do the marks line up? If not, try another strip.

$\frac{1}{2}$
$+ \frac{1}{5}$

The marks do not line up.
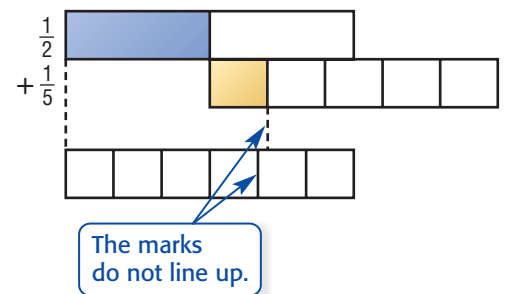
STEP 4 Once the correct strip is found, shade the sections between the beginning of the strip to the point where they line up.

$\frac{1}{2}$
$+ \frac{1}{5}$

$\frac{7}{10}$

The marks line up.
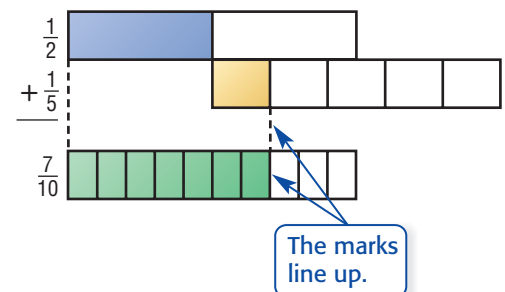
So, $\frac{1}{2} + \frac{1}{5} = \frac{7}{10}$.

CHECK Your Progress Use fraction strips to add.

a. $\frac{1}{10} + \frac{2}{5}$

b. $\frac{1}{6} + \frac{1}{2}$

c. $\frac{1}{2} + \frac{3}{4}$

ACTIVITY

2 Use fraction strips to find $\frac{7}{8} - \frac{3}{4}$.

STEP 1 Model each fraction.

$\frac{7}{8}$

$\frac{3}{4}$

STEP 2 To subtract, line up the ends of the shaded parts of each strip.

$\frac{7}{8}$
$-\frac{3}{4}$

STEP 3 Test different fraction strips below the model, checking to see if the marks line up. Then shade the sections between the beginning of the strip and the point where they line up.

$\frac{7}{8}$
$-\frac{3}{4}$

$\frac{1}{8}$

The marks line up.
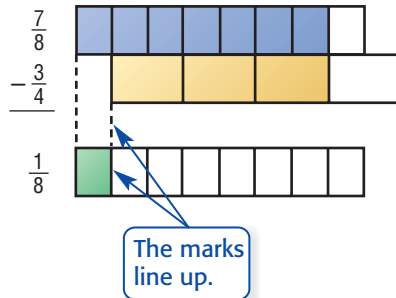
So, $\frac{7}{8} - \frac{3}{4} = \frac{1}{8}$.

✓ CHECK Your Progress

Use fraction strips to subtract.

d. $\frac{3}{8} - \frac{1}{4}$

e. $\frac{8}{9} - \frac{1}{3}$

f. $\frac{2}{3} - \frac{1}{4}$

ANALYZE THE RESULTS

Use the models from Activities 1 and 2 to complete the following.

1. $\frac{1}{2} + \frac{1}{5} = \frac{\blacksquare}{10} + \frac{\blacksquare}{10}$

2. $\frac{7}{8} - \frac{3}{4} = \frac{\blacksquare}{8} - \frac{\blacksquare}{8}$

Write an addition or subtraction expression for each model. Then add or subtract.

3.

4.

5. **MAKE A CONJECTURE** What is the relationship between the number of separations on the answer fraction strip and the denominators of the fractions added or subtracted?

Adding and Subtracting Fractions with Unlike Denominators

GET READY for the Lesson

MEASUREMENT The table shows the fractions of one hour for different minutes.

1. Write each fraction in simplest form.
2. What fraction of one hour is equal to the sum of 15 minutes and 20 minutes? Write in simplest form.
3. Explain why $\frac{1}{6}$ hour + $\frac{1}{3}$ hour = $\frac{1}{2}$ hour.
4. Explain why $\frac{1}{12}$ hour + $\frac{1}{2}$ hour = $\frac{7}{12}$ hour.

Number of Minutes	Fraction of One Hour
1	$\frac{1}{60}$
5	$\frac{5}{60}$
10	$\frac{10}{60}$
15	$\frac{15}{60}$
20	$\frac{20}{60}$
30	$\frac{30}{60}$
45	$\frac{45}{60}$

Before you can add two **unlike fractions**, or fractions with different denominators, one or both of the fractions must be renamed so that they have a common denominator.

Add or Subtract Unlike Fractions   Key Concept

To add or subtract fractions with different denominators,
• Rename the fractions using the least common denominator (LCD).
• Add or subtract as with like fractions.
• If necessary, simplify the sum or difference.

EXAMPLE   Add Unlike Fractions

1 Find $\frac{1}{2} + \frac{1}{4}$.

METHOD 1   Use a model.
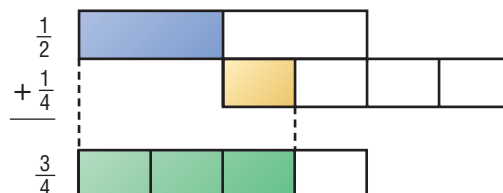
$\frac{1}{2}$

$+ \frac{1}{4}$

$\frac{3}{4}$

The least common denominator of $\frac{1}{2}$ and $\frac{1}{4}$ is 4.

Write the problem.	Rename using the LCD, 4.			Add the fractions.
$\frac{1}{2}$	$\longrightarrow$	$\frac{1 \times 2}{2 \times 2}$	$= \frac{2}{4} \longrightarrow$	$\frac{2}{4}$
$+\frac{1}{4}$	$\longrightarrow$	$+\frac{1 \times 1}{4 \times 1}$	$= +\frac{1}{4} \longrightarrow$	$+\frac{1}{4}$
				$\frac{3}{4}$

✓ CHOOSE Your Method

Add. Write in simplest form.

a. $\frac{1}{6} + \frac{2}{3}$ b. $\frac{9}{10} + \frac{1}{2}$ c. $\frac{1}{4} + \frac{3}{8}$

EXAMPLE   **Subtract Unlike Fractions**

2 Find $\frac{2}{3} - \frac{1}{2}$.

METHOD 1   Use a model.
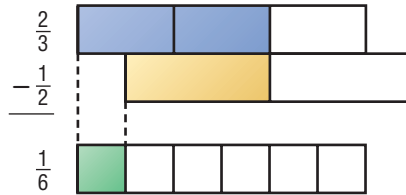
$\frac{2}{3}$

$-\frac{1}{2}$

$\frac{1}{6}$

METHOD 2   Use the LCD.

The least common denominator of $\frac{2}{3}$ and $\frac{1}{2}$ is 6.

Write the problem.	Rename using the LCD, 6.			Subtract the fractions.
$\frac{2}{3}$	$\longrightarrow$	$\frac{2 \times 2}{3 \times 2}$	$= \frac{4}{6} \longrightarrow$	$\frac{4}{6}$
$-\frac{1}{2}$	$\longrightarrow$	$-\frac{1 \times 3}{2 \times 3}$	$= -\frac{3}{6} \longrightarrow$	$-\frac{3}{6}$
				$\frac{1}{6}$

✓ CHOOSE Your Method

Subtract. Write in simplest form.

d. $\frac{5}{8} - \frac{1}{4}$ e. $\frac{3}{4} - \frac{1}{3}$ f. $\frac{1}{2} - \frac{2}{5}$

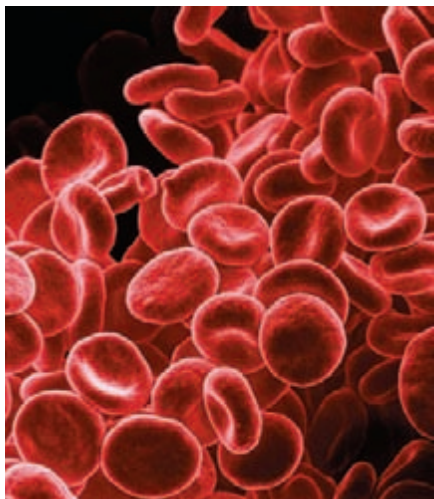**3** **HEALTH** Use the table to find the fraction of the population that has type A or type B blood.

Blood Type Frequencies				
ABO Type	O	A	B	AB
Fraction	$\frac{11}{25}$	$\frac{21}{50}$	$\frac{1}{10}$	$\frac{1}{25}$

Source: Palomar College

Find $\frac{21}{50} + \frac{1}{10}$.

The least common denominator of $\frac{21}{50}$ and $\frac{1}{10}$ is 50.

Write the problem. Rename using the LCD, 50. Add the fractions.

$$\frac{21}{50} \longrightarrow \frac{21 \times 1}{50 \times 1} = \frac{21}{50} \longrightarrow \frac{21}{50}$$

$$+\frac{1}{10} \longrightarrow +\frac{1 \times 5}{10 \times 5} = +\frac{5}{50} \longrightarrow +\frac{5}{50}$$

$$\frac{26}{50} \text{ or } \frac{13}{25}$$

So, $\frac{13}{25}$ of the population has type A or type B blood.

Real-World Link . . . .
Two to three drops of blood contain about one billion red blood cells.

CHECK Your Progress

g. **SURVEY** The table shows the results of an online survey of over 36,000 youth. How much greater was the part of youth that said their favorite way to be "artsy" was by drawing than by acting?

What is your favorite way to be artsy?

Drawing $\frac{8}{25}$
Acting $\frac{7}{50}$
Making music $\frac{7}{50}$
Taking pictures $\frac{11}{100}$
Writing $\frac{3}{50}$

Source: PBS Kids

EXAMPLE **Evaluate an Expression with Fractions**

4 **ALGEBRA** Evaluate $a - b$ if $a = \frac{3}{4}$ and $b = \frac{1}{6}$.

Study Tip

Look Back You can review evaluating expressions in Lesson 1-5.

$$a - b = \frac{3}{4} - \frac{1}{6} \qquad \text{Replace } a \text{ with } \frac{3}{4} \text{ and } b \text{ with } \frac{1}{6}.$$

$$= \frac{3 \times 3}{4 \times 3} - \frac{1 \times 2}{6 \times 2} \qquad \text{Rename } \frac{3}{4} \text{ and } \frac{1}{6} \text{ using the LCD, 12.}$$

$$= \frac{9}{12} - \frac{2}{12} \qquad \text{Simplify.}$$

$$= \frac{7}{12} \qquad \text{Subtract the numerators.}$$

CHECK Your Progress

h. **ALGEBRA** Evaluate $c + d$ if $c = \frac{2}{5}$ and $d = \frac{3}{10}$.

Examples 1, 2
(pp. 263–264)

Add or subtract. Write in simplest form.

1. $\dfrac{2}{3}$
$+\dfrac{2}{9}$

2. $\dfrac{1}{4}$
$+\dfrac{5}{8}$

3. $\dfrac{2}{3}$
$-\dfrac{1}{2}$

4. $\dfrac{3}{5}$
$-\dfrac{1}{2}$

5. $\dfrac{3}{10}+\dfrac{1}{5}$

6. $\dfrac{2}{3}+\dfrac{1}{4}$

7. $\dfrac{3}{4}-\dfrac{1}{8}$

8. $\dfrac{5}{7}-\dfrac{1}{2}$

Example 3
(p. 265)

9. **TOOLS** A certain drill set includes drill bits ranging from $\dfrac{1}{16}$ inch to $\dfrac{1}{4}$ inch. What is the range of drill bits in this set?

Example 4
(p. 265)

ALGEBRA Evaluate each expression.

10. $x + y$ if $x = \dfrac{5}{6}$ and $y = \dfrac{7}{12}$

11. $r - s$ if $r = \dfrac{7}{10}$ and $s = \dfrac{1}{4}$

▶ **Practice and** **Problem Solving**

For Exercises	See Examples
12–27	1, 2
28, 29	3
30, 31	4

HOMEWORK HELP

Add or subtract. Write in simplest form.

12. $\dfrac{3}{8}$
$+\dfrac{1}{4}$

13. $\dfrac{2}{5}$
$+\dfrac{1}{2}$

14. $\dfrac{9}{10}$
$-\dfrac{1}{2}$

15. $\dfrac{5}{8}$
$-\dfrac{1}{4}$

16. $\dfrac{1}{6}$
$+\dfrac{3}{4}$

17. $\dfrac{1}{4}$
$+\dfrac{2}{3}$

18. $\dfrac{5}{6}$
$-\dfrac{7}{10}$

19. $\dfrac{3}{4}$
$-\dfrac{2}{5}$

20. $\dfrac{8}{9}+\dfrac{1}{2}$

21. $\dfrac{5}{7}+\dfrac{1}{2}$

22. $\dfrac{9}{10}-\dfrac{2}{5}$

23. $\dfrac{7}{8}-\dfrac{3}{4}$

24. $\dfrac{7}{8}+\dfrac{3}{4}$

25. $\dfrac{7}{12}+\dfrac{2}{3}$

26. $\dfrac{3}{4}-\dfrac{2}{7}$

27. $\dfrac{9}{11}-\dfrac{1}{2}$

ANALYZE TABLES For Exercises 28 and 29, use the table showing the fraction of total coupon book sales of four students in a class.

28. What is the difference between Jabar's and Corey's fraction of total sales?

29. What part of the total sales did Billy and Domanick have altogether?

Coupon Book Sales	
Student	**Fraction of Total Sales**
Corey	$\dfrac{1}{12}$
Billy	$\dfrac{3}{40}$
Domanick	$\dfrac{1}{3}$
Jabar	$\dfrac{2}{15}$

ALGEBRA Evaluate each expression.

30. $a + b$ if $a = \dfrac{7}{10}$ and $b = \dfrac{5}{6}$

31. $x - y$ if $x = \dfrac{4}{5}$ and $y = \dfrac{1}{2}$

Use the order of operations to add or subtract. Write in simplest form.

32. $\frac{9}{10} + \frac{2}{3} - \frac{11}{15}$ 　　　　 **33.** $\frac{7}{12} + \frac{5}{8} + \frac{5}{6}$ 　　　　 **34.** $\frac{15}{16} - \frac{1}{3} - \frac{1}{12}$

Write an addition or subtraction sentence for each model.

35.

36.
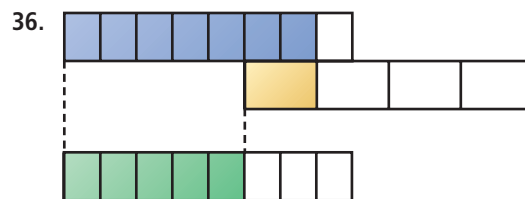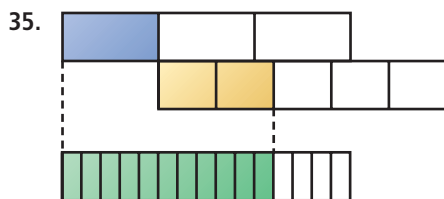
Use fraction strips to model each expression. Then add or subtract.

37. $\frac{1}{3} + \frac{1}{6}$ 　　　　　　 **38.** $\frac{5}{8} - \frac{1}{2}$ 　　　　　　 **39.** $\frac{5}{6} + \frac{2}{3}$

40. GARDENING Suppose an herb plant grew $\frac{9}{16}$ inch the first week and $\frac{7}{8}$ inch the second week. How much more did the herb plant grow the second week? Justify your solution.

ANALYZE TABLES For Exercises 41–43, use the table.

41. What portion of the Earth's landmass is Asia and Africa?

42. How much more is the landmass of North America than South America?

43. What portion of Earth's landmass is Antarctica, Europe, Australia, and Oceania?

Continent or Island Group	Portion of Earth's Landmass
Antarctica, Europe, Australia, and Oceania	▪
Asia	$\frac{3}{10}$
Africa	$\frac{1}{5}$
North America	$\frac{1}{6}$
South America	$\frac{1}{8}$

Source: *Oxford Atlas of the World*

44. STUDYING Nikki knows that studying each night is better than cramming for a test. Thus, she makes a habit of studying every night for $\frac{3}{5}$ of an hour on math and $\frac{3}{4}$ of an hour on English. Which subject does she spend more time studying and by how much?

H.O.T. Problems

45. OPEN ENDED Create and use a model to represent the sum of two fractions with unlike denominators.

46. FIND THE ERROR Simona and Kenji are finding $\frac{5}{8} + \frac{1}{4}$. Who is correct? Explain your reasoning.

$$\frac{5}{8} + \frac{1}{4} = \frac{5+1}{8+4}$$
$$= \frac{6}{12} \text{ or } \frac{1}{2}$$

$$\frac{5}{8} + \frac{1}{4} = \frac{5}{8} + \frac{2}{8}$$
$$= \frac{5+2}{8}$$
$$= \frac{7}{8}$$

Simona 　　　　　　　　　　 Kenji

CHALLENGE Decide whether each sentence is *sometimes, always,* or *never* true. Explain your reasoning.

47. The sum of two fractions that are less than 1 is less than 1.

48. The difference of two fractions is less than both fractions.

49. **WRITING IN MATH** Write a problem about a real-world situation in which you would subtract $\frac{4}{5}$ and $\frac{3}{4}$.

ISTEP+ PRACTICE 6.1.6

50. Hernando made a drawing of his bedroom. The length of his drawing is $\frac{3}{4}$ foot, and the width is $\frac{1}{3}$ foot less than the length. Find the width of the drawing.

   A $\frac{1}{4}$ ft

   B $\frac{5}{12}$ ft

   C $\frac{7}{12}$ ft

   D $1\frac{1}{12}$ ft

51. On a camping trip, Rebecca hiked $\frac{5}{8}$ mile to a cave, and then $\frac{1}{4}$ mile inside the cave. Each strip below represents 1 mile. Which strip is shaded to show the total number of miles, one way, Rebecca hiked?

   F ▢▢▢▢▢▢▢▢

   G ▢▢▢▢▢▢▢

   H ▢▢▢▢▢▢

   J ▢▢▢▢▢▢▢▢

Spiral Review

Add or subtract. Write in simplest form. (Lesson 5-3)

52. $\frac{7}{10} + \frac{1}{10}$ **53.** $\frac{3}{8} - \frac{1}{8}$ **54.** $\frac{5}{18} + \frac{7}{18}$ **55.** $\frac{11}{20} - \frac{3}{20}$

56. **PAPER FOLDING** Paloma folded a piece of paper in half vertically. Then she folded it in half horizontally. If she repeats this process one more time and opens up the piece of paper, how many regions will be separated by the fold lines? Use the *act it out* strategy. (Lesson 5-2)

BASKETBALL For Exercises 57 and 58, use the stem-and-leaf plot that shows the number of points the basketball team scored each game this season. (Lesson 2-4)

57. What is the fewest number of points the team scored?

58. How many games did the team score 57 points?

Basketball Team Points

Stem	Leaf
3	9
4	3 5 5 7 8 9
5	0 0 2 4 7 7 7
6	0 2

$4|3 = 43$ points

▷ GET READY for the Next Lesson

PREREQUISITE SKILL Replace each ▨ with a number so that the fractions are equivalent. (Lesson 4-2)

59. $\frac{3}{4} = \frac{▨}{12}$ **60.** $\frac{1}{8} = \frac{▨}{24}$ **61.** $\frac{1}{3} = \frac{▨}{12}$ **62.** $\frac{5}{6} = \frac{▨}{18}$

READING to SOLVE PROBLEMS

Meaning of Subtraction

You know that one meaning of subtraction is *to take away.* But there are other meanings too. Look for these meanings when you're solving a word problem.

🔴 To take away

Chad found $\frac{5}{8}$ of a pizza in the refigerator. He ate $\frac{1}{8}$ of the original pizza. How much of the original pizza is left?
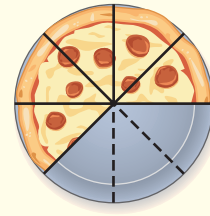
🔴 To find a missing addend

Heather made a desktop by gluing a sheet of oak veneer to a sheet of $\frac{3}{4}$-inch plywood. The total thickness of the desktop is $\frac{13}{16}$ inch. What was the thickness of the oak veneer?

🔴 To compare the size of two sets

Yesterday, it rained $\frac{7}{8}$ inch. Today, it rained $\frac{1}{4}$ inch. How much more did it rain yesterday than today?
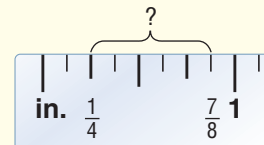
PRACTICE

1. Solve each problem above.

Identify the meaning of subtraction shown in each problem. Then solve the problem.

2. Marcus opened a carton of milk and drank $\frac{1}{4}$ of it. How much of the carton of milk is left?

3. How much bigger is a $\frac{15}{16}$-inch wrench than a $\frac{3}{8}$-inch wrench?

4. Part of a hiking trail is $\frac{3}{4}$ mile long. When you pass the $\frac{1}{8}$-mile marker, how much farther is it until the end of the trail?

5. A cornbread recipe calls for $\frac{3}{4}$ cup of cornmeal. Ali has only $\frac{1}{4}$ cup. How much more cornmeal does she need?

Adding and Subtracting Mixed Numbers

▷ MINI Lab

You can use paper plates to add and subtract mixed numbers.

STEP 1 Cut a paper plate into fourths and another plate into halves.

STEP 2 Use one whole plate and three fourths of a plate to show the mixed number $1\frac{3}{4}$.

STEP 3 Use two whole plates and one half of a plate to show $2\frac{1}{2}$.

STEP 4 Make as many whole paper plates as you can.

1. How many whole paper plates can you make?

2. What fraction is represented by the leftover pieces?

Use paper plate models to find each sum or difference.

3. $1\frac{3}{4} + 2\frac{1}{2}$ 4. $2\frac{3}{4} - 1\frac{1}{4}$ 5. $1\frac{2}{3} + 2\frac{1}{6}$

The Mini Lab suggests the following rule.

Add and Subtract Mixed Numbers   Key Concept

• Add or subtract the fractions.
• Then add or subtract the whole numbers.
• Rename and simplify if necessary.

EXAMPLES   Add or Subtract Mixed Numbers

1 Find $4\frac{5}{6} - 2\frac{1}{6}$.   **Estimate** $5 - 2 = 3$

Subtract the fractions.   Subtract the whole numbers.

$$4\frac{5}{6} \qquad \rightarrow \qquad 4\frac{5}{6}$$
$$-\,2\frac{1}{6} \qquad \rightarrow \qquad -\,2\frac{1}{6}$$
$$\overline{\frac{4}{6}} \qquad\qquad \overline{2\frac{4}{6}} \text{ or } 2\frac{2}{3}$$

Check for Reasonableness $2\frac{2}{3} \approx 3$ ✔

2 Find $5\frac{1}{4} + 10\frac{2}{3}$. **Estimate** $5 + 11 = 16$

Write the problem.	Rename the fractions using the LCD, 12.	Add the fractions. Then add the whole numbers.

$$5\frac{1}{4} \rightarrow \frac{1 \times 3}{4 \times 3} \rightarrow 5\frac{3}{12} \rightarrow 5\frac{3}{12}$$

$$+\, 10\frac{2}{3} \rightarrow \frac{2 \times 4}{3 \times 4} \rightarrow +\, 10\frac{8}{12} \rightarrow +\, 10\frac{8}{12}$$

$$15\frac{11}{12}$$

Check for Reasonableness $15\frac{11}{12} \approx 16$ ✔

✓ **CHECK Your Progress**

Add or subtract. Write in simplest form.

a. $5\frac{2}{8} + 3\frac{1}{8}$ b. $5\frac{1}{2} - 2\frac{1}{3}$ c. $6\frac{2}{5} + 3\frac{1}{2}$

EXAMPLES **Rename Numbers to Subtract**

3 Find $5 - 2\frac{7}{8}$. **Estimate** $5 - 3 = 2$

$$5 \quad\rightarrow\quad 4\frac{8}{8} \quad \text{Rename 5 as } 4\frac{8}{8}.$$

$$-\, 2\frac{7}{8} \quad\rightarrow\quad -\, 2\frac{7}{8}$$

$$2\frac{1}{8} \quad \text{Subtract.}$$

Check for Reasonableness $2\frac{1}{8} \approx 2$ ✔

$$5 \quad = \quad 4\frac{8}{8}$$

Study Tip

Compensation You can calculate $5 - 2\frac{7}{8}$ mentally.

Think: $2\frac{7}{8} + \frac{1}{8} = 3$

$5 + \frac{1}{8} = 5\frac{1}{8}$

Since $5\frac{1}{8} - 3 = 2\frac{1}{8}$,

$5 - 2\frac{7}{8} = 2\frac{1}{8}$.
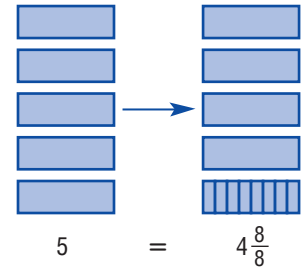
4 Find $12\frac{1}{8} - 9\frac{1}{4}$. **Estimate** $12 - 9 = 3$

Step 1 $12\frac{1}{8} \rightarrow 12\frac{1}{8}$ ⟵ Rename $\frac{1}{8}$ and $\frac{1}{4}$ using their LCD, 8.

$-\, 9\frac{1}{4} \rightarrow -\, 9\frac{2}{8}$

Step 2 $12\frac{1}{8} \rightarrow 11\frac{9}{8}$ ⟵ Rename $12\frac{1}{8}$ as $11\frac{8}{8} + \frac{1}{8}$ or $11\frac{9}{8}$.

$-\, 9\frac{2}{8} \rightarrow -\, 9\frac{2}{8}$

$$2\frac{7}{8}$$

Check for Reasonableness $2\frac{7}{8} \approx 3$ ✔

✓ **CHECK Your Progress**

d. $5 - 3\frac{1}{2}$ e. $7 - 2\frac{1}{4}$ f. $2 - 1\frac{6}{7}$

g. $11\frac{1}{2} - 7\frac{1}{8}$ h. $6\frac{2}{5} - 3\frac{3}{5}$ i. $8\frac{7}{10} - 6\frac{3}{4}$

5 Refer to the table. How much longer is the NBA basketball court than the Olympic basketball court?

Sport	Length of Court (ft)	Width of Court (ft)
Olympic Basketball	$91\frac{5}{6}$	$49\frac{1}{6}$
NBA Basketball	94	50

A $3\frac{1}{6}$ feet   **C** $2\frac{1}{6}$ feet

B $2\frac{5}{6}$ feet   **D** $1\frac{1}{6}$ feet

Test-Taking Tip

Eliminating Choices
By estimating $94 - 91\frac{5}{6}$, you know the difference must be greater than 2 feet and less than 3 feet. So, you can eliminate choices A and D.

Read the Item You need to find $94 - 91\frac{5}{6}$.

Solve the Item

$$94 \quad \rightarrow \quad 93\frac{6}{6} \qquad \text{Rename 94 as } 93\frac{6}{6}.$$

$$\begin{array}{r} -91\frac{5}{6} \rightarrow -91\frac{5}{6} \\ \hline 2\frac{1}{6} \end{array}$$

The NBA court is $2\frac{1}{6}$ feet longer than the Olympic court. The answer is C.

CHECK Your Progress

d. A recipe for pumpkin bread calls for $3\frac{1}{4}$ cups flour, and a recipe for cornbread calls for $1\frac{1}{3}$ cups flour. How much more flour is needed for pumpkin bread than cornbread?

F $2\frac{11}{12}$ c   **G** $2\frac{7}{12}$ c   **H** $2\frac{1}{12}$ c   **J** $1\frac{11}{12}$ c

CHECK Your Understanding

Examples 1–4
(pp. 270–271)

Add or subtract. Write in simplest form.

1. $\begin{array}{r} 5\frac{3}{4} \\ -1\frac{1}{4} \\ \hline \end{array}$

2. $\begin{array}{r} 2\frac{3}{8} \\ +4\frac{1}{8} \\ \hline \end{array}$

3. $\begin{array}{r} 14\frac{3}{5} \\ -6\frac{3}{10} \\ \hline \end{array}$

4. $6\frac{9}{10} + 8\frac{1}{4}$

5. $3\frac{2}{3} - 2\frac{4}{5}$

6. $4\frac{1}{3} - 1\frac{3}{4}$

Example 5
(p. 272)

7. **MULTIPLE CHOICE** A g-force is a unit of measurement for an object being accelerated. A roller coaster has a g-force of $4\frac{3}{5}$. A second roller coaster has a g-force of $3\frac{1}{2}$. How much greater is the g-force of the first roller coaster than the second?

A $\frac{9}{10}$ **B** $1\frac{1}{10}$ **C** $1\frac{1}{5}$ **D** $2\frac{1}{5}$

Add or subtract. Write in simplest form.

8. $\begin{array}{r} 3\frac{5}{6} \\ +\,4\frac{1}{6} \\ \hline \end{array}$

9. $\begin{array}{r} 4\frac{5}{12} \\ +\,6\frac{7}{12} \\ \hline \end{array}$

10. $\begin{array}{r} 4\frac{5}{8} \\ -\,2\frac{3}{8} \\ \hline \end{array}$

11. $\begin{array}{r} 9\frac{4}{5} \\ -\,4\frac{2}{5} \\ \hline \end{array}$

12. $6\frac{3}{5} + \frac{4}{5}$

13. $3\frac{3}{8} + 6\frac{5}{8}$

14. $7\frac{7}{9} - 4\frac{1}{3}$

15. $6\frac{6}{7} - 4\frac{5}{14}$

16. $7 - 5\frac{1}{2}$

17. $9 - 3\frac{3}{5}$

18. $4\frac{1}{4} - 2\frac{3}{4}$

19. $9\frac{3}{8} - 6\frac{5}{8}$

20. $12\frac{1}{5} - 5\frac{3}{10}$

21. $8\frac{1}{3} - 1\frac{5}{6}$

22. $14\frac{3}{8} - 5\frac{3}{4}$

23. $10\frac{5}{9} - 3\frac{2}{3}$

24. **DELI** Caroline bought $2\frac{1}{4}$ pounds of turkey and $1\frac{2}{3}$ pounds of roast beef. How much more turkey than roast beef did Caroline buy?

25. **PAINTING** Pamela is going to paint three different rooms. She will need $2\frac{1}{2}$ gallons of paint for the first room, $4\frac{1}{3}$ gallons of paint for the second room, and $3\frac{3}{4}$ gallons of paint for the third room. How much paint does Pamela need for all three rooms?

26. **ANALYZE TABLES** Sei ("say") whales can reach different sizes based on their location. Find the difference between the longest and shortest sei whales according to their location. Justify your solution.

Sei Whale Lengths	
Location	**Length (feet)**
Southern Hemisphere	$65\frac{3}{5}$
North Pacific	61
North Atlantic	$56\frac{4}{5}$

Source: Sea World

27. **DISTANCE** Neil lives $3\frac{1}{2}$ blocks from Dario's house. Dario lives $2\frac{1}{4}$ blocks from the library, and the video store is $1\frac{1}{8}$ blocks from the library. How far will Neil travel if he walks from his home to Dario's house, the library, and then the video store?

Write an addition or subtraction expression for each model. Then add or subtract.

28.

29.

30. **FIND THE ERROR** Karen and Daniel are finding $7\frac{1}{2} - 4$. Who is correct? Explain your reasoning.

$$7\frac{1}{2} - 4 = 7\frac{1}{2} - 3\frac{2}{2}$$
$$= 4\frac{1}{2}$$

Karen

$$7\frac{1}{2} - 4 = 3\frac{1}{2}$$

Daniel

31. **CHALLENGE** Use the digits 1, 1, 2, 2, 3, and 4 to create two mixed numbers with a sum of $4\frac{1}{4}$.

32. **WRITING IN MATH** Describe a method of renaming $5\frac{3}{7}$ as $4\frac{10}{7}$ that involves mental math. Explain why your method works.

ISTEP+ PRACTICE 6.1.6

33. Mrs. Matthews bought $2\frac{2}{3}$ pounds of fish, $4\frac{1}{2}$ pounds of chicken, and $3\frac{1}{4}$ pounds of beef. How many pounds did she buy altogether?

A $10\frac{5}{12}$ lb

B $10\frac{1}{3}$ lb

C 10 lb

D $9\frac{3}{4}$ lb

34. Trey's hamster weighs $14\frac{1}{8}$ ounces and Gina's hamster weighs $12\frac{2}{3}$ ounces. How much more does Trey's hamster weigh than Gina's?

F $2\frac{11}{24}$ oz

G $1\frac{1}{2}$ oz

H $1\frac{11}{24}$ oz

J $1\frac{1}{4}$ oz

Spiral Review

Add or subtract. Write in simplest form. (Lessons 5-3 and 5-4)

35. $\frac{1}{3} + \frac{1}{3}$

36. $\frac{9}{10} - \frac{3}{10}$

37. $\frac{4}{5} - \frac{3}{4}$

38. $\frac{7}{9} + \frac{5}{12}$

39. **VIDEO GAMES** Corey bought a video game that cost $37.85 and paid with $40. Is $2, $3, or $4 a reasonable amount for how much change he received? (Lesson 3-10)

GET READY for the Next Lesson

PREREQUISITE SKILL **Round each number to the nearest half.** (Lesson 5-1)

40. $1\frac{2}{5}$

41. $7\frac{4}{9}$

42. $5\frac{3}{8}$

43. $2\frac{5}{6}$

44. $2\frac{1}{12}$

Round each number to the nearest half. (Lesson 5-1)

1. $\frac{7}{8}$ **2.** $3\frac{2}{7}$ **3.** $6\frac{3}{4}$

4. STICKERS Find the length of the sticker to the nearest half inch. (Lesson 5-1)

Great Job!

5. SCHOOL It takes Monica $1\frac{3}{4}$ minutes to walk to the bus stop. Should she leave her house $1\frac{1}{2}$ minutes or 2 minutes before the bus arrives? (Lesson 5-1)

6. MAZES In a corn maze, you begin by walking north. You turn at the next right and then at the next left. In which direction are you facing now? Use the *act it out* strategy. (Lesson 5-2)

7. ART Tia is making a sign with her name to hang in her bedroom. She wants each letter of her name to be a different color. How many different ways can she write her name using red, green, and yellow markers? Use the *act it out* strategy. (Lesson 5-2)

Add or subtract. Write in simplest form. (Lesson 5-3)

8. $\frac{5}{9} + \frac{7}{9}$ **9.** $\frac{9}{11} - \frac{5}{11}$ **10.** $\frac{1}{6} + \frac{5}{6}$

11. MEASUREMENT How much longer is a section of rope measuring $\frac{11}{16}$ inch than a section of rope measuring $\frac{7}{16}$ inch? Write in simplest form. (Lesson 5-3)

Add or subtract. Write in simplest form. (Lesson 5-4)

12. $\frac{5}{8} + \frac{3}{4}$ **13.** $\frac{2}{3} - \frac{1}{2}$ **14.** $\frac{3}{5} + \frac{5}{6}$

15. MULTIPLE CHOICE On Tuesday, Trent spent $\frac{11}{20}$ hour on the Internet. On Wednesday, he spent $\frac{8}{15}$ hour on the Internet. How much more time did Trent spend on the Internet on Tuesday than on Wednesday? (Lesson 5-4)

A $\frac{1}{60}$ hour   **C** $\frac{1}{15}$ hour

B $\frac{1}{20}$ hour   **D** $\frac{1}{12}$ hour

Add or subtract. Write in simplest form. (Lesson 5-5)

16. $1\frac{5}{12} + 4\frac{4}{12}$ **17.** $5\frac{1}{8} - 3\frac{1}{2}$ **18.** $8\frac{1}{6} + 7\frac{3}{4}$

19. CRAFTS Tiffany cut $1\frac{9}{32}$ inches from each side of a square piece of scrapbook paper. If the scrapbook paper now measures $5\frac{1}{4}$ inches on each side, what was its original side length? (Lesson 5-5)

20. MULTIPLE CHOICE To win horse racing's Triple Crown, a horse must win all three races shown. How much longer is the longest race than the shortest? (Lesson 5-5)

Race	Length (mi)
Kentucky Derby	$1\frac{1}{4}$
Preakness Stakes	$1\frac{3}{16}$
Belmont Stakes	$1\frac{1}{2}$

F $\frac{1}{4}$ mi   **H** $\frac{1}{2}$ mi

G $\frac{5}{16}$ mi   **J** $1\frac{1}{16}$ mi

Estimating Products of Fractions

MAIN IDEA

Estimate products of fractions using compatible numbers and rounding.

New Vocabulary

compatible numbers

IN Math Online

glencoe.com
• Extra Examples
• Personal Tutor
• Self-Check Quiz

▶ **GET READY** for the Lesson

NATURE A wildlife preserve has 16 tigers, of which about $\frac{1}{3}$ are male. Use 16 counters to represent the 16 tigers.

1. Can you separate the counters into three groups so that each group has the same number of counters? Explain.

2. What multiple of 3 is closest to 16?

3. About how many tigers in the preserve are male? Explain.
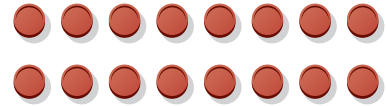
One way to estimate products involving fractions is to use **compatible numbers**, or numbers that are easy to divide mentally.

EXAMPLES **Estimate Using Compatible Numbers**

1 Estimate $\frac{1}{4} \times 13$. $\frac{1}{4} \times 13$ means $\frac{1}{4}$ of 13.

Find a multiple of 4 close to 13.

$\frac{1}{4} \times 13 \approx \frac{1}{4} \times 12$ 12 and 4 are compatible numbers since $12 \div 4 = 3$.

     ≈ 3 $12 \div 4 = 3.$

So, $\frac{1}{4} \times 13$ is *about* 3.
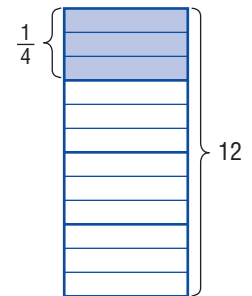
2 Estimate $\frac{2}{5}$ of 11.

$\frac{1}{5} \times 11 \approx \frac{1}{5} \times 10$ Use 10 since 10 and 5 are compatible numbers.

     ≈ 2 $10 \div 5 = 2$

If $\frac{1}{5}$ of 10 is 2, then $\frac{2}{5}$ of 10 is 2×2, or 4.

So, $\frac{2}{5} \times 11$ is *about* 4.
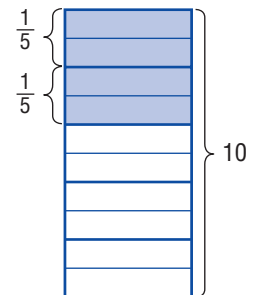
✓ **CHECK** Your Progress

Estimate each product.

a. $\frac{1}{5} \times 16$ b. $\frac{5}{6} \times 13$ c. $\frac{3}{4}$ of 23

EXAMPLE **Estimate by Rounding to 0, $\frac{1}{2}$, or 1**

3 Estimate $\frac{1}{3} \times \frac{7}{8}$.

$\frac{1}{3} \times \frac{7}{8} \rightarrow \frac{1}{2} \times 1$

$\frac{1}{2} \times 1 = \frac{1}{2}$

So, $\frac{1}{3} \times \frac{7}{8}$ is *about* $\frac{1}{2}$.

$\boxed{\frac{1}{3} \text{ is about } \frac{1}{2}.}$ $\boxed{\frac{7}{8} \text{ is about } 1.}$
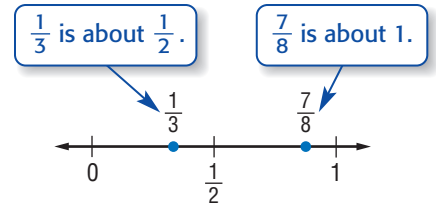
✓ CHECK Your Progress

Estimate each product.

d. $\frac{5}{8} \times \frac{9}{10}$ e. $\frac{5}{6} \times \frac{9}{10}$ f. $\frac{5}{6}$ of $\frac{1}{9}$

EXAMPLE **Estimate With Mixed Numbers**

Study Tip

Look Back You can review rounding fractions in Lesson 5-1.

4 **MEASUREMENT** Estimate the area of the flower bed.

Round each mixed number to the nearest whole number.

$14\frac{7}{8} \times 6\frac{1}{3} \quad \rightarrow \quad 15 \times 6 = 90$

$\boxed{\text{Round } 14\frac{7}{8} \text{ to 15.}}$ $\boxed{\text{Round } 6\frac{1}{3} \text{ to 6.}}$

$6\frac{1}{3}$ ft

$14\frac{7}{8}$ ft

So, the area is *about* 90 square feet.
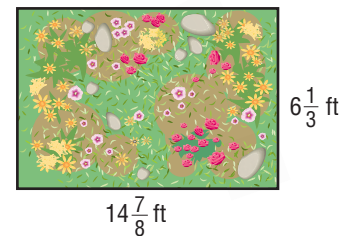
✓ CHECK Your Progress

g. **MEASUREMENT** A border is made up of $32\frac{2}{3}$ bricks that are $1\frac{1}{6}$ feet long. About how long is the border?

✓ CHECK Your Understanding

Examples 1–4
(pp. 276–277)

Estimate each product.

1. $\frac{1}{8} \times 15$ 2. $\frac{3}{4} \times 21$ 3. $\frac{2}{5}$ of 26   4. $\frac{1}{10}$ of 68

5. $\frac{1}{4} \times \frac{8}{9}$ 6. $\frac{5}{8} \times \frac{1}{9}$ 7. $6\frac{2}{3} \times 4\frac{1}{5}$ 8. $\frac{9}{10} \times 10\frac{3}{4}$

Example 4
(p. 277)

9. **MEASUREMENT** Hakeem's front porch measures $9\frac{3}{4}$ feet by 4 feet. Estimate the area of his front porch.

10. **MEASUREMENT** A kitchen measures $24\frac{1}{6}$ feet by $9\frac{2}{3}$ feet. Estimate the area of the kitchen.

Practice and Problem Solving

Estimate each product.

11. $\frac{1}{4} \times 21$ **12.** $\frac{1}{5} \times 26$ **13.** $\frac{1}{3}$ of 41   **14.** $\frac{1}{6}$ of 17

15. $\frac{5}{7}$ of 22   **16.** $\frac{2}{9}$ of 88   **17.** $\frac{2}{3} \times 10$ **18.** $\frac{3}{8} \times 4$

19. PIZZA Cyrus is inviting 11 friends over for pizza. He would like to have enough pizza so each friend can have $\frac{1}{4}$ of a pizza. About how many pizzas should he order?

20. BOOKS Tara would like to finish $\frac{2}{5}$ of her book by next Friday. If the book has 203 pages, about how many pages does she need to read?

Estimate each product.

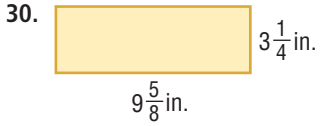**21.** $\frac{5}{7} \times \frac{1}{9}$ **22.** $\frac{1}{10} \times \frac{7}{8}$ **23.** $\frac{11}{12} \times \frac{3}{8}$ **24.** $\frac{2}{5} \times \frac{9}{10}$

25. $4\frac{1}{3} \times 2\frac{3}{4}$ **26.** $6\frac{4}{5} \times 4\frac{1}{9}$ **27.** $5\frac{1}{8} \times 9\frac{1}{12}$ **28.** $2\frac{9}{10} \times 8\frac{5}{6}$

Estimate the area of each rectangle.

29.

$5\frac{3}{4}$ ft

$8\frac{1}{8}$ ft

30.

$3\frac{1}{4}$ in.

$9\frac{5}{8}$ in.
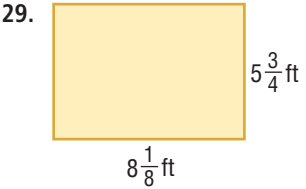
31. VACATION The circle graph shows when people pack for a vacation. Suppose 58 people were surveyed. About how many people pack the day they leave?

32. MEASUREMENT A wall measures $8\frac{1}{2}$ feet by $12\frac{3}{4}$ feet. If a gallon of paint covers about 150 square feet, will one gallon of paint be enough to cover the wall? Explain.

When Vacationers Pack

1 day before leaving $\frac{1}{2}$

2 or more days before leaving $\frac{9}{20}$

the day they leave $\frac{1}{20}$

Source: Carlson Wagonlit Travel Survey

BAKING For Exercises 33 and 34, use the recipe shown, which Angelina is using to make a cake.

33. A cup of walnuts weighs about 8 ounces. About how many ounces are called for in the recipe?

34. If Angelina wants to make 3 cakes, about how many cups of milk will she need?

Recipe: Turtle Cake
1 3/4 cups milk
3 1/2 cups flour
2 cups chocolate
1 cup caramel
1/3 cup walnuts

35. WEATHER Seattle, Washington, received rain on $\frac{7}{10}$ of the days in a recent month. If this pattern continues, about how many days would it rain in 90 days?

36. SELECT A TECHNIQUE Which of the following techniques could you use to easily determine whether an answer is reasonable to the multiplication of $4\frac{10}{11}$ by $7\frac{1}{13}$? Justify your response.

| mental math | number sense | estimation |

37. CHALLENGE Determine which point on the number line could be the graph of the product of the numbers graphed at C and D. Explain your reasoning.

38. WRITING IN MATH Write a real-world problem that can be solved by estimating $\frac{3}{5} \times 21$. Then solve using compatible numbers.

ISTEP+ PRACTICE **Preparation for 6.1.6, P.6.1**

39. Which is the best estimate of the area of the rectangle?

$2\frac{2}{3}$ yd

$1\frac{5}{6}$ yd
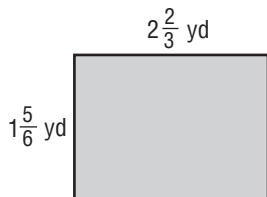
A 2 yd²   **C** 4 yd²

B 3 yd²   **D** 6 yd²

40. A total of 133 sixth-grade students went to a local museum. Of these, between one half and three fourths packed their lunch. Which of the following ranges could represent the number of students who packed their lunch?

F Less than 65

G Between 65 and 100

H Between 100 and 130

J More than 130

Spiral Review

41. COOKING A recipe for enchiladas calls for $1\frac{1}{4}$ pounds of ground beef and $\frac{1}{3}$ pound of cheddar cheese. How much more ground beef is needed than cheese? (Lesson 5-5)

Add or subtract. Write in simplest form. (Lesson 5-4)

42. $\frac{2}{3} + \frac{4}{5}$ **43.** $\frac{8}{9} - \frac{1}{3}$ **44.** $\frac{5}{6} + \frac{5}{12}$ **45.** $\frac{9}{10} - \frac{1}{2}$

46. FOOD Three people equally share 7.5 ounces of juice. How much juice does each receive? (Lesson 3-8)

47. MEASUREMENT Find the area of a rectangle with a length of 17 yards and a width of 42 yards. (Lesson 1-9)

GET READY for the Next Lesson

PREREQUISITE SKILL **Find the GCF of each set of numbers.** (Lesson 4-1)

48. 6, 9   **49.** 10, 4   **50.** 15, 9   **51.** 24, 16

Math Lab
Multiplying Fractions

In Explore 3-7, you used decimal models to multiply decimals. You can use a similar model to multiply fractions.

ACTIVITY

1. **Find $\frac{1}{3} \times \frac{1}{2}$ using a model.**

To find $\frac{1}{3} \times \frac{1}{2}$, find $\frac{1}{3}$ of $\frac{1}{2}$.

Begin with a square to represent 1.

Shade $\frac{1}{2}$ of the square yellow.

Shade $\frac{1}{3}$ of the square blue. The part that was shaded both yellow and blue appears green.

One sixth of the square is shaded green. So, $\frac{1}{3} \times \frac{1}{2} = \frac{1}{6}$.

✓ CHECK Your Progress

Find each product using a model.

a. $\frac{1}{4} \times \frac{1}{2}$ b. $\frac{1}{3} \times \frac{1}{4}$ c. $\frac{1}{2} \times \frac{1}{5}$

ANALYZE THE RESULTS

1. Describe how you would change the model to find $\frac{1}{2} \times \frac{1}{3}$. Is the product the same as $\frac{1}{3} \times \frac{1}{2}$? Explain.

2 Find $\frac{3}{5} \times \frac{2}{3}$ using a model. Write in simplest form.

To find $\frac{3}{5} \times \frac{2}{3}$, find $\frac{3}{5}$ of $\frac{2}{3}$.

Begin with a square to represent 1.
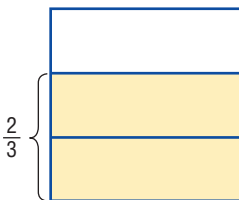
$\frac{2}{3}$ { Shade $\frac{2}{3}$ of the square yellow.
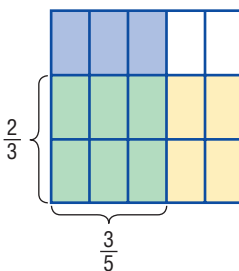
$\frac{2}{3}$ { Shade $\frac{3}{5}$ of the square blue.

$\frac{3}{5}$

Six out of 15 parts are shaded green. So, $\frac{3}{5} \times \frac{2}{3} = \frac{6}{15}$ or $\frac{2}{5}$.

Study Tip

Multiplying Fractions
Finding $\frac{3}{5} \times \frac{2}{3}$ is the same as finding $\frac{2}{3} \times \frac{3}{5}$. So, you could also begin by shading $\frac{3}{5}$ of the square yellow and then $\frac{2}{3}$ of the square blue.

✓ CHECK Your Progress

Find each product using a model. Then write in simplest form.

d. $\frac{3}{4} \times \frac{2}{3}$ e. $\frac{2}{5} \times \frac{5}{6}$ f. $\frac{4}{5} \times \frac{3}{8}$

ANALYZE THE RESULTS

2. Draw a model to show that $\frac{2}{3} \times \frac{5}{6} = \frac{10}{18}$. Then explain how the model shows that $\frac{10}{18}$ simplifies to $\frac{5}{9}$.

3. Explain the relationship between the numerators of the problem and the numerator of the product. What do you notice about the denominators of the problem and the denominator of the product?

4. **MAKE A CONJECTURE** Write a rule you can use to multiply fractions.
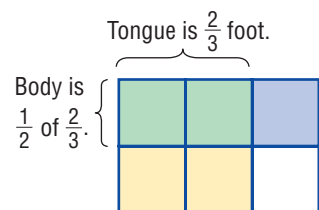
Multiplying Fractions

GET READY for the Lesson

REPTILES A chameleon's body is about $\frac{1}{2}$ the length of its tongue. A certain chameleon has a tongue that is $\frac{2}{3}$ foot long. The overlapping region represents the length of the chameleon, which is $\frac{1}{2}$ of $\frac{2}{3}$ or $\frac{1}{2} \times \frac{2}{3}$.

1. Refer to the model. What fraction represents $\frac{1}{2} \times \frac{2}{3}$?

2. What is the relationship between the numerators and denominators of the factors and the numerator and denominator of the product?

Tongue is $\frac{2}{3}$ foot.

Body is $\frac{1}{2}$ of $\frac{2}{3}$.

Multiply Fractions   Key Concept

Words   Multiply the numerators and multiply the denominators.

Examples   **Numbers**   **Algebra**

$\frac{2}{5} \times \frac{1}{2} = \frac{2 \times 1}{5 \times 2}$ $\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$, where b and d are not 0.

EXAMPLE   Multiply Fractions

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

$\frac{1}{3} \times \frac{1}{4} = \frac{1 \times 1}{3 \times 4}$ Multiply the numerators.
                                   Multiply the denominators.

$= \frac{1}{12}$ Simplify.

$\frac{1}{4}$

$\frac{1}{3}$
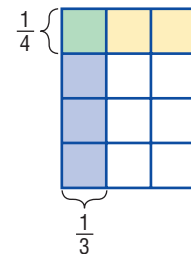
CHECK Your Progress

Multiply. Write in simplest form.

a. $\frac{1}{2} \times \frac{3}{5}$ b. $\frac{1}{3} \times \frac{3}{4}$ c. $\frac{2}{3} \times \frac{5}{6}$

To multiply a fraction and a whole number, first write the whole number as a fraction.

EXAMPLE **Multiply Fractions and Whole Numbers**

2 Find $\frac{3}{5} \times 4$.   **Estimate** $\frac{1}{2} \times 4 = 2$

$\frac{3}{5} \times 4 = \frac{3}{5} \times \frac{4}{1}$ Write 4 as $\frac{4}{1}$.

$= \frac{3 \times 4}{5 \times 1}$ Multiply.

$= \frac{12}{5}$ or $2\frac{2}{5}$ Simplify. Compare to the estimate.
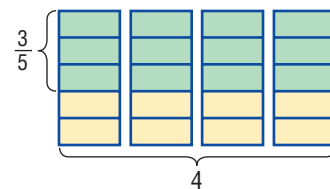
✓ CHECK Your Progress

d. $\frac{2}{3} \times 6$ e. $\frac{3}{4} \times 5$ f. $3 \times \frac{1}{2}$

Review Vocabulary

factor two or more numbers that are multiplied together to form a product; *Example:* 1, 2, 3, and 6 are all factors of 6 (Lesson 1-2)

If the numerators and the denominators have a common factor, you can simplify *before* you multiply.

EXAMPLE **Simplify Before Multiplying**

3 Find $\frac{3}{4} \times \frac{5}{6}$.   **Estimate** $\frac{1}{2} \times 1 = \frac{1}{2}$

$\frac{3}{4} \times \frac{5}{6} = \frac{\overset{1}{\cancel{3}} \times 5}{4 \times \underset{2}{\cancel{6}}}$ Divide both the numerator and the denominator by 3.

$= \frac{5}{8}$ Simplify. Compare to the estimate.

✓ CHECK Your Progress

g. $\frac{3}{4} \times \frac{4}{9}$ h. $\frac{5}{6} \times \frac{9}{10}$ i. $\frac{3}{5} \times 10$

EXAMPLE **Evaluate Expressions**

4 **ALGEBRA** Evaluate ab if $a = \frac{2}{3}$ and $b = \frac{3}{8}$.

$ab = \frac{2}{3} \times \frac{3}{8}$ Replace a with $\frac{2}{3}$ and b with $\frac{3}{8}$.

$= \frac{\overset{1}{\cancel{2}} \times \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \times \underset{4}{\cancel{8}}}$ The GCF of 2 and 8 is 2. The GCF of 3 and 3 is 3. Divide both the numerator and the denominator by 2 and then by 3.

$= \frac{1}{4}$ Simplify.

Study Tip

Mental Math You can multiply some fractions mentally. For example, $\frac{1}{3}$ of $\frac{3}{8} = \frac{1}{8}$. So, $\frac{2}{3}$ of $\frac{3}{8} = \frac{2}{8}$ or $\frac{1}{4}$.

✓ CHECK Your Progress

j. Evaluate $\frac{3}{4} c$ if $c = \frac{2}{5}$.   k. Evaluate $5a$ if $a = \frac{3}{10}$.

Examples 1–3
(pp. 282–283)

Multiply. Write in simplest form.

1. $\frac{1}{8} \times \frac{1}{2}$

2. $\frac{2}{3} \times \frac{4}{5}$

3. $\frac{4}{5} \times 10$

4. $\frac{3}{4} \times 12$

5. $\frac{3}{10} \times \frac{5}{6}$

6. $\frac{3}{5} \times \frac{5}{6}$

Example 2
(p. 283)

7. **FROGS** The male Cuban tree frog is about $\frac{2}{5}$ the size of the female Cuban tree frog. The average size of the female Cuban tree frog is shown at the right. What is the size of the male Cuban tree frog?

6 in.
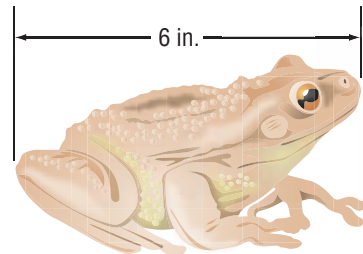
Example 4
(p. 283)

8. **ALGEBRA** Evaluate xy if $x = \frac{1}{4}$ and $y = \frac{5}{6}$.

Practice and Problem Solving

Multiply. Write in simplest form.

9. $\frac{1}{3} \times \frac{2}{5}$

10. $\frac{1}{8} \times \frac{3}{4}$

11. $\frac{3}{4} \times \frac{5}{8}$

12. $\frac{2}{5} \times \frac{3}{7}$

13. $\frac{3}{4} \times 2$

14. $\frac{2}{3} \times 4$

15. $\frac{5}{6} \times 15$

16. $\frac{3}{8} \times 11$

17. $\frac{2}{3} \times \frac{1}{4}$

18. $\frac{3}{5} \times \frac{5}{7}$

19. $\frac{4}{9} \times \frac{3}{8}$

20. $\frac{2}{5} \times \frac{5}{6}$

ALGEBRA Evaluate each expression if $a = \frac{3}{5}$, $b = \frac{1}{2}$, and $c = \frac{1}{3}$.

21. ab

22. bc

23. $\frac{1}{3}a$

24. $\frac{6}{7}c$

25. **ANIMALS** A sloth spends about $\frac{4}{5}$ of its life asleep. If a sloth lives to be 28 years old, how many years did it spend asleep?

26. **RIVERS** The Mississippi River is the second longest river in the United States, second only to the Missouri River. The Mississippi River is about $\frac{23}{25}$ the length of the Missouri River. If the Missouri River is 2,540 miles long, how long is the Mississippi River?

27. **WEATHER** In a recent year, the weather was partly cloudy $\frac{2}{5}$ of the days. Assuming there are 365 days in a year, how many days were partly cloudy?

28. **PIZZA** Alvin ate $\frac{5}{8}$ of a pizza. If there were 16 slices of pizza, how many slices did Alvin eat?

Multiply.

29. $\frac{1}{2} \times \frac{1}{3} \times \frac{1}{4}$

30. $\frac{2}{3} \times \frac{3}{4} \times \frac{2}{3}$

31. $\frac{1}{2} \times \frac{2}{5} \times \frac{15}{16}$

32. $\frac{2}{3} \times \frac{9}{10} \times \frac{5}{9}$

ALGEBRA Use the order of operations to evaluate each expression if $x = \frac{4}{5}$, $y = \frac{3}{7}$, and $z = \frac{7}{10}$.

33. $\frac{2}{3}xz$

34. xyz

35. $\frac{3}{4}x + z$

36. $\frac{7}{8}y + \frac{5}{7}z$

37. **GEOGRAPHY** Michigan's area is 96,810 square miles. Water makes up about $\frac{2}{5}$ of the area of the state. About how many square miles of water does Michigan have?

38. **HEALTH** About $\frac{1}{15}$ of a pint of blood is pumped through the human body with every heartbeat. If the average human heart beats 72 times per minute, how many quarts of blood are pumped through the human body each minute? $\left(Hint\text{: } 1 \text{ pint} = \frac{1}{2} \text{ quart}\right)$

39. **FRANCE** In a poll of the students in Lily's French class, $\frac{1}{6}$ have been to France. Of these, 4 have been to Paris. Would 18, 26, or 30 be a reasonable number of students in Lily's French class? Explain.

40. **RECYCLING** In a community survey, $\frac{13}{20}$ of residents claim to recycle. Of these, $\frac{1}{4}$ recycle only paper products. If there are 720 residents, how many residents recycle only paper products?

H.O.T. Problems

41. **OPEN ENDED** Create a model to explain why $\frac{2}{3} \times \frac{1}{2} = \frac{1}{3}$.

REASONING State whether each statement is *true* or *false*. If the statement is *false*, provide a counterexample.

42. The product of two fractions that are each between 0 and 1 is also between 0 and 1.

43. The product of a mixed number between 4 and 5 and a fraction between 0 and 1 is less than 4.

44. The product of two mixed numbers that are each between 4 and 5 is between 16 and 25.

45. **NUMBER SENSE** If the product of two positive fractions, a and b, is $\frac{15}{56}$, find three pairs of possible values for a and b.

46. **CHALLENGE** Is the product of two positive fractions, that are each less than 1, also less than 1? Explain.

47. **WRITING IN MATH** Explain why $\frac{a}{b} \times \frac{b}{c} \times \frac{c}{d} \times \frac{d}{e}$ is equal to $\frac{a}{e}$.

48. In a recent survey, $\frac{5}{8}$ of pet owners stated that they allow their pet to go outside. Of these, $\frac{1}{3}$ allow their pet outside without supervision. Which expression gives the fraction of the pet owners surveyed that allow their pet outside without supervision?

   A $\frac{5}{8} + \frac{1}{3}$

   B $\frac{5}{8} - \frac{1}{3}$

   C $\frac{5}{8} \times \frac{1}{3}$

   D $\frac{5}{8} \div \frac{1}{3}$

49. There are 150 students in the band and 90 students in the chorus. One half of the band members and $\frac{4}{5}$ of the chorus members participated in a charity concert. How many more band members than chorus members participated in the concert?

   F 3

   G 18

   H 27

   J 72

Spiral Review

Estimate each product. (Lesson 5-6)

50. $\frac{1}{6}$ of 29

51. $1\frac{8}{9} \times 5\frac{1}{6}$

52. $\frac{1}{7} \times \frac{35}{6}$

53. $\frac{4}{9} \times \frac{8}{9}$

54. **MEASUREMENT** How much longer is $\frac{7}{8}$ of a mile than $\frac{5}{6}$ of a mile? (Lesson 5-5)

55. **MAGAZINES** Samuel receives a car magazine once every four weeks, a music magazine once every six weeks, and a movie magazine once every nine weeks. If he received all three magazines this week, in how many weeks will he receive all three magazines again? (Lesson 4-5)

56. **SCHEDULING** Fatima is scheduling the five courses shown at the right. Social studies is only offered first or second period. In how many different ways can the classes be scheduled if she has science class after art class and if English must be the first period of the day? (Lesson 4-4)

Courses
Science
Social Studies
Mathematics
Art
English

57. **RESTAURANTS** Marcus and four friends went to dinner at a local restaurant. The total cost of each friend's bill was $14.78, $15.24, $14.87, $15.42, and $14.75. Write these bills in order from least to greatest. (Lesson 3-2)

GET READY for the Next Lesson

PREREQUISITE SKILL Write each mixed number as an improper fraction. (Lesson 4-3)

58. $3\frac{1}{4}$

59. $5\frac{2}{3}$

60. $2\frac{5}{7}$

61. $6\frac{5}{8}$

Multiplying Mixed Numbers

▷ **GET READY** for the Lesson

ANATOMY The Atlantic Giant Squid has an eyeball that is about 12 times as large as the average human eyeball. If the average human eyeball is $1\frac{1}{4}$ inches across, how large is the Atlantic Giant Squid's eyeball?

1. Write a multiplication expression that shows the size of the Atlantic Giant Squid's eyeball.

2. Use repeated addition to find $12 \times 1\frac{1}{4}$. (*Hint:* $12 \times 1\frac{1}{4}$ means there are 12 groups of $1\frac{1}{4}$.)

3. Write the multiplication expression from Exercise 1 using improper fractions.

4. Multiply the improper fractions from Exercise 3. How large is the Atlantic Giant Squid's eyeball?
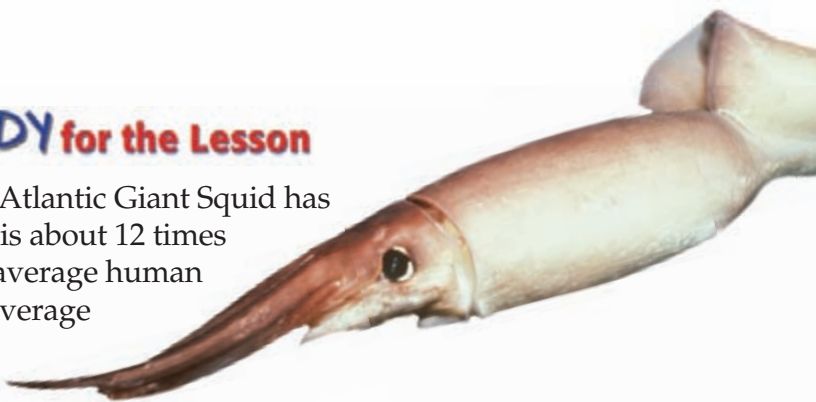
Multiplying mixed numbers is similar to multiplying fractions.

Multiply Mixed Numbers   Key Concept

To multiply mixed numbers, write the mixed numbers as improper fractions and then multiply as with fractions.

EXAMPLE   **Multiply a Fraction and a Mixed Number**

① Find $\frac{1}{4} \times 4\frac{4}{5}$.   **Estimate** Use compatible numbers ⟶ $\frac{1}{4} \times 4 = 1$

$$\frac{1}{4} \times 4\frac{4}{5} = \frac{1}{4} \times \frac{24}{5} \qquad \text{Write } 4\frac{4}{5} \text{ as } \frac{24}{5}.$$

$$= \frac{1 \times \overset{6}{\cancel{24}}}{\underset{1}{\cancel{4}} \times 5} \qquad \text{Divide 24 and 4 by their GCF, 4.}$$

$$= \frac{6}{5} \text{ or } 1\frac{1}{5} \qquad \text{Simplify. Compare to the estimate.}$$

✔ **CHECK Your Progress**

Multiply. Write in simplest form.

a. $\frac{2}{3} \times 2\frac{1}{2}$ b. $\frac{3}{8} \times 3\frac{1}{3}$ c. $3\frac{1}{2} \times \frac{1}{3}$

EXAMPLE **Multiply Mixed Numbers**

2 **DAMS** Hoover Dam contains $4\frac{1}{2}$ million cubic yards of concrete. The Grand Coulee Dam, in Washington state, contains $2\frac{2}{3}$ times as much concrete. How much concrete does it contain?

Estimate $4 \times 3 = 12$

$$4\frac{1}{2} \times 2\frac{2}{3} = \frac{9}{2} \times \frac{8}{3} \qquad \text{Write the mixed numbers as improper fractions.}$$

$$= \frac{\overset{3}{\cancel{9}}}{\underset{1}{\cancel{2}}} \times \frac{\overset{4}{\cancel{8}}}{\underset{1}{\cancel{3}}} \qquad \text{Divide 9 and 3 by their GCF, 3. Then divide 8 and 2 by their GCF, 2.}$$

$$= \frac{3}{1} \times \frac{4}{1} \qquad \text{Multiply the numerators and multiply the denominators.}$$

$$= \frac{12}{1} \text{ or } 12 \qquad \text{Simplify.}$$

There are 12 million cubic yards of concrete in the Grand Coulee Dam.

Real-World Link . . . . .
The Hoover Dam, located on the Arizona-Nevada border, contains enough concrete to pave a highway, 16 feet wide, from San Francisco to New York City.

Source: U.S. Department of the Interior

✓ **CHECK Your Progress**

d. **MEASUREMENT** Mr. Wilkins is laying bricks to make a rectangular patio. The area he is covering with bricks is $15\frac{1}{2}$ feet by $9\frac{3}{4}$ feet. What is the area of the patio?

EXAMPLE **Evaluate Expressions**

3 **ALGEBRA** If $c = 1\frac{7}{8}$ and $d = 3\frac{1}{3}$, what is the value of cd?

$$cd = 1\frac{7}{8} \times 3\frac{1}{3} \qquad \text{Replace } c \text{ with } 1\frac{7}{8} \text{ and } d \text{ with } 3\frac{1}{3}.$$

$$= \frac{\overset{5}{\cancel{15}}}{\underset{4}{\cancel{8}}} \times \frac{\overset{5}{\cancel{10}}}{\underset{1}{\cancel{3}}} \qquad \text{Divide the numerator and denominator by 3 and by 2.}$$

$$= \frac{25}{4} \text{ or } 6\frac{1}{4} \qquad \text{Simplify.}$$

✓ **CHECK Your Progress**

e. **ALGEBRA** If $a = 3\frac{1}{5}$ and $b = 2\frac{3}{4}$, what is the value of ab?

✓ **CHECK Your Understanding**

Examples 1, 2
(pp. 287–288)

Multiply. Write in simplest form.

1. $\frac{1}{2} \times 2\frac{3}{8}$ **2.** $1\frac{1}{2} \times \frac{2}{3}$ **3.** $1\frac{3}{4} \times 2\frac{4}{5}$

Example 2
(p. 288)

4. **COOKING** A waffle recipe calls for $2\frac{1}{4}$ cups of flour. If Chun wants to make $1\frac{1}{2}$ times the recipe, how much flour does he need?

Example 3
(p. 288)

5. **ALGEBRA** If $x = \frac{9}{10}$ and $y = 1\frac{1}{3}$, find xy.

Multiply. Write in simplest form.

6. $\frac{1}{2} \times 2\frac{1}{3}$

7. $\frac{3}{4} \times 2\frac{5}{6}$

8. $1\frac{7}{8} \times \frac{4}{5}$

9. $1\frac{4}{5} \times \frac{5}{6}$

10. $\frac{7}{8} \times 3\frac{1}{4}$

11. $\frac{3}{10} \times 2\frac{5}{6}$

12. $1\frac{1}{3} \times 1\frac{1}{4}$

13. $3\frac{1}{5} \times 3\frac{1}{6}$

14. $3\frac{3}{4} \times 2\frac{2}{5}$

15. $4\frac{1}{2} \times 2\frac{5}{6}$

16. $6\frac{2}{3} \times 3\frac{3}{10}$

17. $3\frac{3}{5} \times 5\frac{5}{12}$

ALGEBRA Evaluate each expression if $a = \frac{2}{3}$, $b = 3\frac{1}{2}$, and $c = 1\frac{3}{4}$.

18. ab

19. $\frac{1}{2}c$

20. bc

21. $\frac{1}{8}a$

22. **MEASUREMENT** A reproduction of Claude Monet's *Water-Lilies* has dimensions $34\frac{1}{2}$ inches by $36\frac{1}{2}$ inches. Find the area of the painting.

23. **ANIMALS** A three-toed sloth can travel at a speed of $\frac{3}{20}$ mile per hour. At this rate, how far can a three-toed sloth travel in $2\frac{1}{2}$ hours?

Multiply. Write in simplest form.

24. $\frac{3}{4} \times 2\frac{1}{2} \times \frac{4}{5}$

25. $1\frac{1}{2} \times \frac{2}{3} \times \frac{3}{5}$

26. $3\frac{2}{5} \times 4\frac{1}{2} \times 2\frac{2}{3}$

27. $\frac{1}{7} \times 5\frac{5}{6} \times 1\frac{1}{4}$

28. **RUNNING** Use the formula $d = rt$ to find the distance d a long-distance runner can run at a rate r of $9\frac{1}{2}$ miles per hour for time t of $1\frac{3}{4}$ hours.

ASTRONOMY For Exercises 29–32, use the table and the following information.

Earth is about $92\frac{9}{10}$ million miles from the Sun.

29. How far is Venus from the Sun?

30. How far is Mars from the Sun?

31. How far is Jupiter from the Sun?

32. How far is Saturn from the Sun?

Planet	Approximate Number of Times as Far from the Sun as Earth
Venus	$\frac{3}{4}$
Mars	$1\frac{1}{2}$
Jupiter	$5\frac{1}{4}$
Saturn	$9\frac{1}{2}$

Source: *World Almanac for Kids*

33. **FIND THE DATA** Refer to the Data File on pages 16–19. Choose some data and write a real-world problem in which you would multiply mixed numbers.
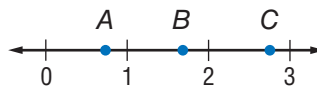
ALGEBRA Evaluate each expression if $g = 5\frac{3}{4}$, $k = 2\frac{1}{3}$, and $h = 1\frac{7}{8}$.

34. $gk + h$

35. gkh

36. $gh - k$

37. **OPEN ENDED** Find two positive mixed numbers, each greater than 1 and less than 2, with a product greater than 1 and less than 2.

38. **NUMBER SENSE** Without multiplying, determine whether the product $2\frac{1}{2} \times \frac{2}{3}$ is located on the number line at point A, B, or C. Explain your reasoning.

39. **CHALLENGE** Determine if the product of two positive mixed numbers is *always*, *sometimes*, or *never* less than 1. Explain your reasoning.

40. **WRITING IN MATH** Summarize how to multiply mixed numbers.

ISTEP+ PRACTICE 6.1.6

41. The table shows some ingredients needed to make lasagna.

mozzarella cheese	chopped onion	tomato sauce
$3\frac{1}{2}$ cups	$\frac{1}{4}$ cup	$2\frac{2}{3}$ cups

If you make four times the recipe, how many cups of tomato sauce are needed?

A $9\frac{3}{4}$ c
B $10\frac{1}{2}$ c
C $10\frac{2}{3}$ c
D $5\frac{1}{3}$ c

42. Dario buys a bag of lawn fertilizer that weighs $35\frac{3}{4}$ pounds. He wants to use $\frac{1}{2}$ of the bag on his front lawn. How many pounds of fertilizer will he use on the front lawn?

F $13\frac{5}{8}$ lb
G $17\frac{7}{8}$ lb
H $35\frac{1}{4}$ lb
J $36\frac{1}{4}$ lb

Spiral Review

Multiply. Write in simplest form. (Lesson 5-7)

43. $\frac{5}{7} \times \frac{3}{4}$

44. $\frac{2}{3} \times \frac{1}{6}$

45. $\frac{3}{8} \times \frac{2}{5}$

46. $\frac{1}{2} \times \frac{4}{7}$

47. **RECREATION** There are about 300 million people who visit a national park in the United States each year. If about $\frac{2}{5}$ come from overseas, about how many visitors come from abroad? (Lesson 5-6)

48. **FLOWERS** The table shows the number of each type of flower a florist is using to arrange flower bouquets. Each bouquet will have the same number of each type of flower. What is the greatest number of tulips that can be in each bouquet? (Lesson 4-1)

Flower	Number
roses	32
tulips	24
daisies	40

GET READY for the Next Lesson

PREREQUISITE SKILL **Multiply. Write in simplest form.** (Lesson 5-7)

49. $\frac{1}{4} \times \frac{3}{8}$

50. $\frac{2}{7} \times \frac{3}{4}$

51. $\frac{1}{2} \times \frac{1}{6}$

52. $\frac{2}{5} \times \frac{5}{6}$

Math Lab
Dividing Fractions

There are 8 small prizes that are given away 2 at a time. How many people will get prizes?

1. How many 2s are in 8? Write as a division expression.

Suppose there are two granola bars divided equally among 8 people. What part of a granola bar will each person get?

2. What part of 8 is in 2? Write as a division expression.

ACTIVITY

1 Find $1 \div \frac{1}{5}$ using a model.

STEP 1 Make a model of the dividend, 1.

THINK How many $\frac{1}{5}$s are in 1?

STEP 2 Rename 1 as $\frac{5}{5}$ so the numbers have common denominators. So, the problem is $\frac{5}{5} \div \frac{1}{5}$. Redraw the model to show $\frac{5}{5}$.

How many $\frac{1}{5}$s are in $\frac{5}{5}$?

STEP 3 Circle groups that are the size of the divisor, $\frac{1}{5}$.
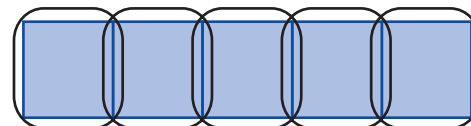
There are five $\frac{1}{5}$s in $\frac{5}{5}$.

So, $1 \div \frac{1}{5} = 5$.

✔ CHECK Your Progress

Find each quotient using a model.

a. $2 \div \frac{1}{5}$ b. $3 \div \frac{1}{3}$ c. $3 \div \frac{2}{3}$ d. $2 \div \frac{3}{4}$

A model can also be used to find the quotient of two fractions.

ACTIVITY

2 Find $\frac{3}{4} \div \frac{3}{8}$ using a model.

STEP 1 Rename $\frac{3}{4}$ as $\frac{6}{8}$ so the fractions have common denominators. So, the problem is $\frac{6}{8} \div \frac{3}{8}$. Draw a model of the dividend, $\frac{6}{8}$.
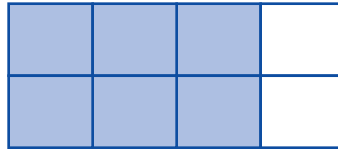
THINK How many $\frac{3}{8}$s are in $\frac{6}{8}$?

STEP 2 Circle groups that are the size of the divisor, $\frac{3}{8}$.
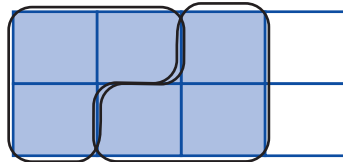
There are two $\frac{3}{8}$s in $\frac{6}{8}$.

So, $\frac{3}{4} \div \frac{3}{8} = 2$.

CHECK Your Progress

Find each quotient using a model.

e. $\frac{4}{10} \div \frac{1}{5}$ f. $\frac{3}{4} \div \frac{1}{2}$ g. $\frac{4}{5} \div \frac{1}{5}$ h. $\frac{1}{6} \div \frac{1}{3}$

ANALYZE THE RESULTS

Use *greater than*, *less than*, or *equal to* to complete each sentence. Then give an example to support your answer.

1. When the dividend is equal to the divisor, the quotient is ▇ 1.

2. When the dividend is greater than the divisor, the quotient is ▇ 1.

3. When the dividend is less than the divisor, the quotient is ▇ 1.

4. **MAKE A CONJECTURE** You know that multiplication is commutative because the product of 3 × 4 is the same as 4 × 3. Is division commutative? Give examples to explain your answer.

Dividing Fractions

▷ MINI Lab

James and his friend Ethan ordered three one-foot submarine sandwiches. They estimate that $\frac{1}{2}$ of a sandwich will serve one person.

1. How many $\frac{1}{2}$-sandwich servings are there?

2. The model shows $3 \div \frac{1}{2}$. What is $3 \div \frac{1}{2}$?
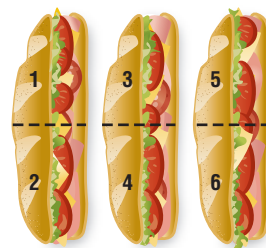
Draw a model to find each quotient.

3. $3 \div \frac{1}{4}$

4. $2 \div \frac{1}{6}$

5. $4 \div \frac{1}{2}$

Dividing by $\frac{1}{2}$ gives the same result as multiplying by 2. The numbers $\frac{1}{2}$ and 2 have a special relationship. Their product is 1. Any two numbers with a product of 1 are called **reciprocals**.

reciprocals

$$3 \div \frac{1}{2} = 6 \qquad 3 \times 2 = 6$$

same result

EXAMPLES Find Reciprocals

1 Find the reciprocal of 5.

Since $5 \times \frac{1}{5} = 1$, the reciprocal of 5 is $\frac{1}{5}$.

2 Find the reciprocal of $\frac{2}{3}$.

Since $\frac{2}{3} \times \frac{3}{2} = 1$, the reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$.

✓ CHECK Your Progress Find the reciprocal of each number.

a. 11

b. $\frac{3}{5}$

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

You can use reciprocals to divide fractions.

Divide Fractions   Key Concept

Words   To divide by a fraction, multiply by its reciprocal.

Examples   **Numbers**   **Algebra**

$\frac{1}{2} \div \frac{2}{3} = \frac{1}{2} \times \frac{3}{2}$ $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$, where b, c, and $d \neq 0$

Divide by a Fraction

3 Find $\frac{1}{8} \div \frac{3}{4}$.

$$\frac{1}{8} \div \frac{3}{4} = \frac{1}{8} \times \frac{4}{3} \qquad \text{Multiply by the reciprocal, } \frac{4}{3}.$$

$$= \frac{1 \times \overset{1}{\cancel{4}}}{\underset{2}{\cancel{8}} \times 3} \qquad \text{Divide 8 and 4 by the GCF, 4.}$$

$$= \frac{1}{6} \qquad \begin{array}{l} \text{Multiply numerators.} \\ \text{Multiply denominators.} \end{array}$$

4 Find $3 \div \frac{1}{2}$.

$$3 \div \frac{1}{2} = \frac{3}{1} \times \frac{2}{1} \qquad \text{Multiply by the reciprocal of } \frac{1}{2}.$$

$$= \frac{6}{1} \text{ or } 6 \qquad \text{Simplify.}$$

✓ CHECK Your Progress

Divide. Write in simplest form.

d. $\frac{1}{4} \div \frac{3}{8}$ e. $\frac{2}{3} \div \frac{3}{8}$ f. $4 \div \frac{3}{4}$

Real-World EXAMPLE **Divide by a Whole Number**

5 CAMP At a summer day camp, $\frac{3}{4}$ of each day is spent in group activities. There are 6 camp counselors who split their time equally as the activity leaders. What fraction of the day is each counselor the activity leader?

Divide $\frac{3}{4}$ into 6 equal parts.

$$\frac{3}{4} \div 6 = \frac{3}{4} \times \frac{1}{6} \qquad \text{Multiply by the reciprocal.}$$

$$= \frac{\overset{1}{\cancel{3}}}{4} \times \frac{1}{\underset{2}{\cancel{6}}} \qquad \text{Divide 3 and 6 by the GCF, 3.}$$

$$= \frac{1}{8} \qquad \text{Simplify.}$$

Each camp counselor spends $\frac{1}{8}$ of his or her day at camp as the activity leader.

✓ CHECK Your Progress

g. **MEASUREMENT** A neighborhood garden that is $\frac{2}{3}$ of an acre is to be divided into 4 equal-size areas. What is the size of each area?

Examples 1, 2
(p. 293)

Find the reciprocal of each number.

1. $\dfrac{2}{3}$ 2. $\dfrac{1}{7}$ 3. $\dfrac{2}{5}$ 4. 4

Examples 3–5
(p. 294)

Divide. Write in simplest form.

5. $\dfrac{1}{4} \div \dfrac{1}{2}$ 6. $\dfrac{5}{6} \div \dfrac{1}{3}$

7. $2 \div \dfrac{1}{3}$ 8. $5 \div \dfrac{2}{7}$

9. $\dfrac{4}{5} \div 2$ 10. $\dfrac{5}{6} \div 3$

Example 5
(p. 294)

11. **HORSES** The average adult horse needs $\dfrac{2}{5}$ bale of hay each day to meet dietary requirements. A horse farm has 44 bales of hay. How many horses can be fed with 44 bales of hay in one day?

Practice and **Problem Solving**

HOMEWORK HELP

For Exercises	See Examples
12–17	1, 2
18–21, 33	3
22–25, 30	4
26–29, 31, 32	5

Find the reciprocal of each number.

12. $\dfrac{1}{4}$ 13. $\dfrac{1}{10}$ 14. $\dfrac{2}{5}$

15. $\dfrac{7}{9}$ 16. 8 17. 1

Divide. Write in simplest form.

18. $\dfrac{1}{8} \div \dfrac{1}{2}$ 19. $\dfrac{1}{2} \div \dfrac{2}{3}$ 20. $\dfrac{3}{4} \div \dfrac{2}{3}$ 21. $\dfrac{3}{4} \div \dfrac{9}{10}$

22. $3 \div \dfrac{3}{4}$ 23. $2 \div \dfrac{3}{5}$ 24. $5 \div \dfrac{3}{4}$ 25. $8 \div \dfrac{4}{7}$

26. $\dfrac{3}{5} \div 6$ 27. $\dfrac{5}{6} \div 5$ 28. $\dfrac{5}{8} \div 2$ 29. $\dfrac{8}{9} \div 4$

30. **FOOD** Rafael had $\dfrac{3}{4}$ of a pumpkin pie left. He divided this into six equal-size slices. What fraction of the original pie was each slice?

31. **MEASUREMENT** Jamar has a piece of plywood that is $\dfrac{8}{9}$ yard long. He wants to cut this into 3 equal-size pieces to use as small shelves in his bedroom. What will be the length of each of these shelves?

32. **TIME** Chelsea devoted $\dfrac{3}{8}$ of her day to run errands, exercise, visit with her friends, and go shopping. If she devotes an equal amount of time to each of these four activities, what fraction of her day is spent on each activity?

33. **MEASUREMENT** A piece of string is to be cut into equal-size pieces. If the length of the string is $\dfrac{11}{12}$ foot long and each piece is to be $\dfrac{1}{24}$ foot long, how many pieces can be cut?

CRAFTS For Exercises 34 and 35, refer to the following information.

To tie-dye one T-shirt, $\frac{3}{8}$ of a cup of dye is needed. The table shows the number of cups of each color of dye in Mr. Nielson's art class.

34. Mr. Nielson notices that he is running out of orange dye. How many T-shirts can be made using only orange dye?

35. Mr. Nielson has three classes. For each class, he wants to use the same amount of red dye. How many T-shirts can be made using only the color red for each class?

Amount of Dye	
Color	Number of Cups
red	12
orange	$\frac{3}{4}$
yellow	2
green	$2\frac{5}{6}$
blue	8
purple	$5\frac{1}{2}$
black	6

ALGEBRA Use the order of operations to evaluate each expression if $a = \frac{2}{3}$, $b = \frac{3}{4}$, and $c = \frac{1}{2}$.

36. $a \div b$ 37. $b \div c - a$ 38. $a \div c$ 39. $c \div b + a$

40. **DATA ANALYSIS** The expression $\left(5\frac{1}{2} + 5\frac{3}{4} + 5\frac{7}{8}\right) \div 3$ gives the mean of the numbers $5\frac{1}{2}$, $5\frac{3}{4}$, and $5\frac{7}{8}$. Use the order of operations to find the mean.

41. **FIND THE DATA** Refer to the Data File on pages 16–19. Choose some data and write a real-world problem in which you would divide fractions.

Academic Standards • ISTEP+

H.O.T. Problems

42. **OPEN ENDED** Find two positive fractions with a quotient of $\frac{5}{6}$.

43. **FIND THE ERROR** Raul and Tom are solving $\frac{8}{9} \div 4$. Who is correct? Explain your reasoning.

$$\frac{8}{9} \div 4 = \frac{8}{9} \times \frac{4}{1}$$
$$= \frac{32}{9} \text{ or } 3\frac{5}{9}$$

$$\frac{8}{9} \div 4 = \frac{8}{9} \times \frac{1}{4}$$
$$= \frac{8}{36} \text{ or } \frac{2}{9}$$

Raul

Tom

CHALLENGE For Exercises 44 and 45, simplify each expression. Then, write one or two sentences describing each result.

44. $\dfrac{a}{b} \div \dfrac{a}{c}$

45. $\dfrac{a}{b} \div \dfrac{c}{b}$

46. **WRITING IN MATH** Create two real-world problems that involve the fraction $\dfrac{1}{2}$ and the whole number 3. One problem should involve multiplication, and the other should involve division.

ISTEP+ PRACTICE 6.1.6

47. In cooking, 1 drop is equal to $\dfrac{1}{6}$ of a dash. If a recipe calls for $\dfrac{2}{3}$ of a dash, which expression would give the number of drops that are needed?

   A $\dfrac{1}{6} + \dfrac{2}{3}$

   B $\dfrac{1}{6} - \dfrac{2}{3}$

   C $\dfrac{1}{6} \times \dfrac{2}{3}$

   D $\dfrac{2}{3} \div \dfrac{1}{6}$

48. Which of the following numbers, when divided by $\dfrac{1}{2}$, gives a result *less than* $\dfrac{1}{2}$?

   F $\dfrac{2}{8}$

   G $\dfrac{7}{12}$

   H $\dfrac{2}{3}$

   J $\dfrac{5}{24}$

Spiral Review

Multiply. Write in simplest form. (Lesson 5-8)

49. $2\dfrac{2}{5} \times 3\dfrac{1}{3}$

50. $1\dfrac{5}{6} \times 2\dfrac{3}{4}$

51. $3\dfrac{3}{7} \times 2\dfrac{3}{8}$

52. $4\dfrac{4}{9} \times 5\dfrac{1}{4}$

53. **VOLUNTEERING** According to a survey, 9 in 10 teens volunteer at least once a year. Of these, about $\dfrac{1}{3}$ help clean up their communities. What fraction of teens volunteer by helping clean up their communities? (Lesson 5-7)

54. **SCHOOL** Nathan, Angelina, and Carlos are each being considered for president, vice president, and secretary of Student Council. In how many ways can the three positions be filled by these students? Use the *make an organized list* strategy. (Lesson 4-4)

GET READY for the Next Lesson

PREREQUISITE SKILL Write each mixed number as an improper fraction. Then find the reciprocal of each. (Lesson 4-3)

55. $1\dfrac{2}{3}$

56. $1\dfrac{5}{9}$

57. $4\dfrac{1}{2}$

58. $3\dfrac{3}{4}$

59. $6\dfrac{4}{5}$

Dividing Mixed Numbers

GET READY for the Lesson

DEPTH The deepest point in Earth's oceans is the Mariana Trench, which is located $6\frac{4}{5}$ miles beneath the ocean's surface. The average depth of Earth's oceans is $2\frac{1}{2}$ miles. By contrast, the highest elevation of Earth is Mt. Everest, which is about $5\frac{1}{2}$ miles high.

Mt. Everest

$5\frac{1}{2}$ miles

Average Ocean Depth

ocean surface

Mariana Trench

$2\frac{1}{2}$ miles

$6\frac{4}{5}$ miles
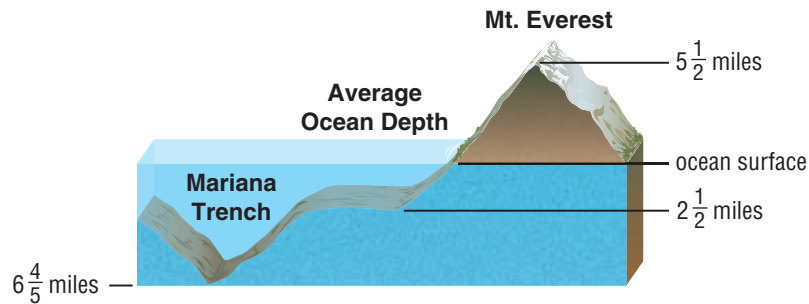
1. Write a division expression to find how many times as tall is Mt. Everest than the depth of the average ocean.

2. Write a division expression to find how many times as deep is the Mariana Trench than the average ocean on Earth.

Dividing mixed numbers is similar to dividing fractions. To divide mixed numbers, write the mixed numbers as improper fractions and then divide as with fractions.

EXAMPLE **Divide by a Mixed Number**

1 Find $5\frac{1}{2} \div 2\frac{1}{2}$.

Estimate $6 \div 3 = 2$

$5\frac{1}{2} \div 2\frac{1}{2} = \frac{11}{2} \div \frac{5}{2}$ Write mixed numbers as improper fractions.

$= \frac{11}{2} \times \frac{2}{5}$ Multiply by the reciprocal.

$= \frac{11}{\cancel{2}_1} \times \frac{\cancel{2}^1}{5}$ Divide 2 and 2 by the GCF, 2.

$= \frac{11}{5}$ or $2\frac{1}{5}$ Simplify.

Check for Reasonableness $2\frac{1}{5} \approx 2$ ✔

CHECK Your Progress **Divide. Write in simplest form.**

a. $4\frac{1}{5} \div 2\frac{1}{3}$ b. $8 \div 2\frac{1}{2}$ c. $1\frac{5}{9} \div 2\frac{1}{3}$

EXAMPLE **Evaluate Expressions**

2 **ALGEBRA** Find $m \div n$ if $m = 1\frac{3}{4}$ and $n = \frac{2}{5}$.

$$m \div n = 1\frac{3}{4} \div \frac{2}{5} \quad \text{Replace } m \text{ with } 1\frac{3}{4} \text{ and } n \text{ with } \frac{2}{5}.$$

$$= \frac{7}{4} \div \frac{2}{5} \quad \text{Write the mixed number as an improper fraction.}$$

$$= \frac{7}{4} \times \frac{5}{2} \quad \text{Multiply by the reciprocal.}$$

$$= \frac{35}{8} \text{ or } 4\frac{3}{8} \quad \text{Simplify.}$$

CHECK Your Progress

d. **ALGEBRA** Find $c \div d$ if $c = 2\frac{3}{8}$ and $d = 1\frac{1}{4}$.

Real-World EXAMPLE

3 **PANDAS** Refer to the information at the left. If the average weight of a male Giant Panda is 330 pounds, how much does the average female Giant Panda weigh? **Estimate** $300 \div 1 = 300$

$$330 \div 1\frac{1}{5} = \frac{330}{1} \div \frac{6}{5} \quad \text{Write the mixed number as an improper fraction.}$$

$$= \frac{330}{1} \times \frac{5}{6} \quad \text{Multiply by the reciprocal.}$$

$$= \frac{\overset{55}{330}}{1} \div \frac{5}{\underset{1}{6}} \quad \text{Divide 330 and 6 by their GCF, 6.}$$

$$= \frac{275}{1} \text{ or } 275 \quad \text{Simplify.}$$

So, the average female Giant Panda weighs about 275 pounds.
Check for Reasonableness $275 \approx 300$ ✔

Real-World Link . . . . .
At birth, a Giant Panda is about the size of a stick of butter. The average adult male weighs about $1\frac{1}{5}$ times as much as the average adult female.
Source: San Diego Zoo

CHECK Your Progress

e. **FUNDRAISING** The soccer team has $16\frac{1}{2}$ boxes of wrapping paper to sell to raise money for team T-shirts. If selling the wrapping paper is split equally among the 12 players, how many boxes should each player sell?

CHECK Your Understanding

Example 1
(p. 298)

Divide. Write in simplest form.

1. $3\frac{1}{2} \div 2$ 2. $8 \div 1\frac{1}{3}$ 3. $3\frac{1}{5} \div \frac{2}{7}$

Example 2
(p. 299)

4. **ALGEBRA** What is the value of $c \div d$ if $c = \frac{3}{8}$ and $d = 1\frac{1}{2}$?

Example 3
(p. 299)

5. **BAKING** Jay is cutting a roll of biscuit dough into slices that are $\frac{3}{8}$ inch thick. If the roll is $10\frac{1}{2}$ inches long, how many slices can he cut?

Divide. Write in simplest form.

6. $5\frac{1}{2} \div 2$ **7.** $4\frac{1}{6} \div 10$ **8.** $3 \div 4\frac{1}{2}$

9. $6 \div 2\frac{1}{4}$ **10.** $6\frac{1}{2} \div \frac{3}{4}$ **11.** $7\frac{4}{5} \div \frac{1}{5}$

12. $6\frac{1}{2} \div 3\frac{1}{4}$ **13.** $8\frac{3}{4} \div 2\frac{1}{6}$ **14.** $3\frac{3}{5} \div 1\frac{4}{5}$

15. $3\frac{3}{4} \div 5\frac{5}{8}$ **16.** $4\frac{2}{3} \div 2\frac{2}{9}$ **17.** $6\frac{3}{5} \div 2\frac{3}{4}$

ALGEBRA Evaluate each expression if $a = 4\frac{4}{5}$, $b = \frac{2}{3}$, $c = 6$, and $d = 1\frac{1}{2}$.

18. $12 \div a$ **19.** $b \div 1\frac{2}{9}$ **20.** $a \div b$

21. $a \div c$ **22.** $c \div d$ **23.** $c \div (ab)$

24. SCIENCE A human has 46 chromosomes. This is $5\frac{3}{4}$ times the number of chromosomes of a fruit fly. How many chromosomes does a fruit fly have?

25. MEASUREMENT Gisele is making a scrapbook in which the pages are $13\frac{1}{2}$ inches long. She wants to place square photos across a page. Each photo is $2\frac{1}{4}$ inches long. How many photos can she place on a page? Assume there is no spacing between photos.

26. CASHEWS How many $\frac{3}{8}$-pound bags of cashews can be made from $6\frac{3}{8}$ pounds of cashews?

27. BORDERS The length of a kitchen wall is $24\frac{2}{3}$ feet long. A border will be placed along the wall of the kitchen. If the border comes in strips that are each $1\frac{3}{4}$ feet long, how many strips of border are needed?

28. EGGS The table gives the official U.S. weight, in minimum ounces per dozen, of eggs. How many times as large is the minimum size per dozen of jumbo eggs than the minimum size per dozen of small eggs?

Official U.S. Weights Egg Classifications of Eggs	
Classification	**Minimum Size per Dozen (lb)**
Small	$1\frac{1}{8}$
Medium	$1\frac{5}{16}$
Large	$1\frac{1}{2}$
Extra Large	$1\frac{11}{16}$
Jumbo	$1\frac{7}{8}$
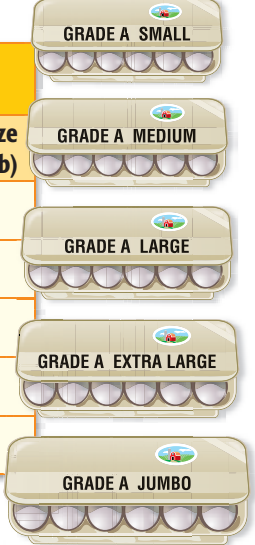
Source: First Science

GRADE A SMALL

GRADE A MEDIUM

GRADE A LARGE

GRADE A EXTRA LARGE

GRADE A JUMBO

HURRICANES For Exercises 29 and 30, use the following information.

Suppose a hurricane traveled 130 miles from a point in the Atlantic Ocean to the Florida coastline in $6\frac{1}{2}$ hours.

29. How many miles per hour did the hurricane travel?

30. How far would the hurricane travel in $1\frac{1}{2}$ hours at the same speed?

31. OPEN ENDED Find two mixed numbers with a quotient of $2\frac{2}{3}$.

32. Which One Doesn't Belong? Select the expression that has a quotient greater than 1. Explain your reasoning.

| $4\frac{2}{3} \div 5\frac{1}{4}$ | $3\frac{1}{8} \div 2\frac{2}{5}$ | $1\frac{6}{7} \div 2\frac{1}{3}$ | $5\frac{3}{4} \div 7\frac{3}{8}$ |

33. CHALLENGE Without dividing, explain whether $5\frac{1}{6} \div 3\frac{5}{8}$ is greater than or less than $5\frac{1}{6} \div 2\frac{2}{5}$.

34. WRITING IN MATH In your own words, explain how to find the quotient of 12 and $2\frac{2}{3}$.

ISTEP+ PRACTICE 6.1.6

35. The largest meteorite crater is in Winslow, Arizona, with a depth of about $\frac{2}{50}$ mile and a distance across of about $\frac{4}{5}$ mile. How many times greater is the distance across the meteorite than its depth?

A about 20　　**C** about $5\frac{1}{2}$

B about $15\frac{1}{2}$　　**D** about 5

36. Lola used $1\frac{1}{2}$ cups of dried apricots to make $\frac{5}{6}$ of her trail mix. How many more cups of dried apricots does she need to finish making her trail mix?

F $\frac{3}{10}$ c　　**H** $\frac{5}{9}$ c

G $\frac{1}{2}$ c　　**J** $\frac{2}{3}$ c

Spiral Review

37. MEASUREMENT If a quart is $\frac{1}{4}$ of a gallon and a pint is $\frac{1}{8}$ of a gallon, how much of a quart is a pint? (Lesson 5-9)

38. TRAINS The fastest recorded train is the TGV in France, with a speed of about 320 miles per hour. How far would this train go in $2\frac{1}{2}$ hours? (Lesson 5-8)

Multiply. Write in simplest form. (Lesson 3-8)

39. $\frac{4}{5} \times 1\frac{3}{4}$ 　　　　**40.** $2\frac{5}{8} \times \frac{2}{7}$ 　　　　**41.** $1\frac{1}{8} \times 5\frac{1}{3}$

Problem Solving in Science

Real-World Unit Project

Space: It's Out of This World! It's time to complete your project. Use the data and information you have gathered about the solar system to prepare a Web page or a poster. Be sure to include several graphs displaying the information you have collected.

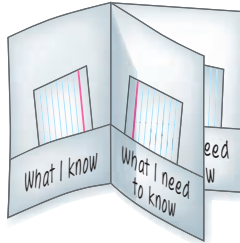**IN Math Online** Unit Project at glencoe.com

FOLDABLES Study Organizer

GET READY to Study

Be sure the following Big Ideas are noted in your Foldable.

What I know | What I need to know | ...eed ...w

BIG Ideas

Fractions with Like Denominators (Lesson 5-3)
To add or subtract fractions with the same denominators follow these steps:
1. Add or subtract the numerators.
2. Use the same denominator in the sum or difference.
3. If necessary, simplify the sum or difference.

Fractions with Unlike Denominators (Lesson 5-4)
To add or subtract fractions with different denominators, follow these steps:
1. Rename the fractions using the least common denominator (LCD).
2. Add or subtract as with like fractions.
3. If necessary, simplify the sum or difference.

Multiplying Fractions (Lessons 5-6 to 5-8)
• To multiply fractions, multiply the numerators and multiply the denominators. Write the result in simplest form.
• To multiply mixed numbers, write the mixed numbers as improper fractions. Then multiply as with fractions. Write the result in simplest form.

Dividing Fractions (Lessons 5-9 and 5-10)
• To divide by a fraction, multiply by its reciprocal. Write the result in simplest form.
• To divide mixed numbers, write the mixed numbers as improper fractions. Then divide as with fractions. Write the result in simplest form.

Key Vocabulary

compatible numbers (p. 276)

like fractions (p. 256)

reciprocal (p. 293)

unlike fractions (p. 263)

Vocabulary Check

State whether each sentence is *true* or *false*. If *false*, replace the underlined word or number to make a true sentence.

1. When painting a wall that is $9\frac{3}{5}$- by $8\frac{1}{4}$-feet, it would make sense to round the number of gallons of paint that is needed <u>up</u> to the nearest gallon.

2. To the nearest half, $5\frac{1}{5}$ rounds to $5\frac{1}{2}$.

3. When adding or subtracting <u>like fractions</u>, use the same denominator in the sum.

4. The product of $\frac{5}{6} \times \frac{2}{7}$ has a denominator of <u>13</u> when simplified.

5. Sometimes it is necessary to rename the fraction part of a mixed number as an <u>improper fraction</u> in order to subtract.

6. The mixed number $9\frac{1}{4}$ can be renamed as $8\frac{5}{4}$.

7. To add or subtract fractions with unlike denominators, first rename the fractions using the <u>GCF</u>.

8. When dividing fractions, multiply by the reciprocal of the <u>first</u> fraction.

9. The LCD of $\frac{1}{8}$ and $\frac{3}{10}$ is <u>80</u>.

Lesson-by-Lesson Review

6.1.6

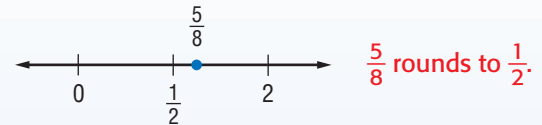## Rounding Fractions and Mixed Numbers (pp. 249–253)

Round each number to the nearest half.

10. $\frac{4}{5}$

11. $4\frac{1}{3}$

12. $6\frac{6}{14}$

13. $\frac{11}{20}$

14. $2\frac{2}{11}$

15. $9\frac{4}{9}$
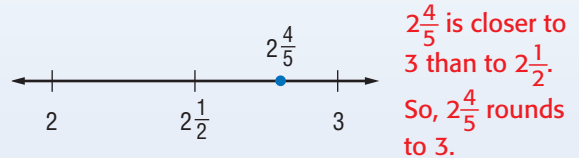
16. **CELL PHONES** Maria wants to buy a carrying case for her $3\frac{1}{5}$-inch cell phone. Cases come in 3-inch, $3\frac{1}{2}$-inch, or 4-inch lengths. Which case size would provide the most appropriate fit for Maria's cell phone?

$3\frac{1}{5}$ in.

Example 1 Round $\frac{5}{8}$ to the nearest half.

$\frac{5}{8}$ rounds to $\frac{1}{2}$.

Example 2 Round $2\frac{4}{5}$ to the nearest half.

$2\frac{4}{5}$ is closer to 3 than to $2\frac{1}{2}$. So, $2\frac{4}{5}$ rounds to 3.

P.1.3

PSI: Act It Out (pp. 254–255)

Solve. Use the *act it out* strategy.

17. **SEATING** In how many different ways can four students be seated in a row of four seats?

18. **WALKING** Kenneth walks at the rate of 1 foot every five seconds while Ebony walks at the rate of 2 feet every five seconds. If Kenneth has a head start of 3 feet, after how many seconds will they be at the same spot?

19. **GAMES** Eight friends are seated in a circle. Juana walks around the circle and lightly taps every third person on the shoulder. How many times does she need to walk around the circle in order to have tapped each person on the shoulder at least once?

Example 3 Drew wants to center the word *manatee* on a square sheet of paper that is 10 inches long. If the dimensions of the word are $7\frac{1}{2}$- by 2-inches, what should the top and side margins of the word be?

Cut a $7\frac{1}{2}$- by 2-inch rectangular piece of paper with the word *manatee* written on it. Place it roughly in the center of a square sheet of paper 10 inches long. Measure the top and side margins to see if they are equal and adjust if necessary. The top margin should be 4 inches. The side margin should be $1\frac{1}{4}$ inches.

5-3   **Adding and Subtracting Fractions with Like Denominators** (pp. 256–260)

6.1.6

Add or subtract. Write in simplest form.

20. $\frac{5}{8} + \frac{1}{8}$ 21. $\frac{7}{12} + \frac{1}{12}$

22. $\frac{7}{10} + \frac{3}{10}$ 23. $\frac{6}{7} - \frac{2}{7}$

24. $\frac{11}{12} - \frac{7}{12}$ 25. $\frac{7}{9} + \frac{4}{9}$

26. **MEASUREMENT** How much longer is $\frac{17}{20}$ hour than $\frac{13}{20}$ hour? Write in simplest form.

27. **MONEY** Michelle's grandmother gave her some money for her birthday. Michelle saved $\frac{5}{8}$ of this amount toward the purchase of a new MP3 player and $\frac{1}{8}$ of this amount toward the purchase of a new bicycle. If she spent the rest, what fraction did she save for these two items? Write in simplest form.

Example 4

Find $\frac{3}{8} + \frac{1}{8}$.   **Estimate** $\frac{1}{2} + 0 = \frac{1}{2}$

$\frac{3}{8} + \frac{1}{8} = \frac{3+1}{8}$ Add the numerators.

$= \frac{4}{8}$ or $\frac{1}{2}$ Simplify.

Example 5

Find $\frac{7}{12} - \frac{5}{12}$.   **Estimate** $\frac{1}{2} - \frac{1}{2} = 0$

$\frac{7}{12} - \frac{5}{12} = \frac{7-5}{12}$ Subtract the numerators.

$= \frac{2}{12}$ or $\frac{1}{6}$ Simplify.

5-4   **Adding and Subtracting Fractions with Unlike Denominators** (pp. 263–268)

6.1.6

Add or subtract. Write in simplest form.

28. $\frac{1}{2} + \frac{2}{3}$ 29. $\frac{5}{8} + \frac{1}{4}$

30. $\frac{7}{9} - \frac{1}{12}$ 31. $\frac{9}{10} - \frac{1}{4}$

32. $\frac{7}{9} - \frac{1}{6}$ 33. $\frac{4}{5} + \frac{2}{10}$

34. **RUNNING** Teresa ran $\frac{5}{6}$ mile while Yolanda ran $\frac{1}{4}$ mile. By what fraction did Teresa run more than Yolanda?

Example 6

Find $\frac{3}{8} + \frac{2}{3}$.   **Estimate** $\frac{1}{2} + \frac{1}{2} = 1$

The LCD of $\frac{3}{8}$ and $\frac{2}{3}$ is 24.

$\frac{3}{8} \rightarrow \frac{3 \times 3}{8 \times 3} \rightarrow \frac{9}{24}$

$+\frac{2}{3} \rightarrow \frac{2 \times 8}{3 \times 8} \rightarrow +\frac{16}{24}$

$\frac{25}{24}$ or $1\frac{1}{24}$

5-5

6.1.6

Adding and Subtracting Mixed Numbers (pp. 270–274)

Add or subtract. Write in simplest form.

35. $3\frac{2}{5} + 1\frac{3}{5}$

36. $9\frac{7}{8} - 5\frac{3}{8}$

37. $7\frac{5}{6} + 9\frac{3}{4}$

38. $4\frac{3}{7} - 2\frac{5}{14}$

39. **ANIMALS** The average length of a giraffe's tongue is $1\frac{1}{2}$ feet long. The average length of a human's tongue is $\frac{1}{3}$ foot long. How much longer is the average giraffe's tongue than the average human's tongue?

Subtract. Write in simplest form.

40. $5 - 3\frac{2}{3}$

41. $6\frac{3}{8} - 3\frac{5}{6}$

42. $12\frac{2}{5} - 9\frac{2}{3}$

43. $8\frac{5}{8} - 1\frac{3}{4}$

44. **BAKING** A recipe for pumpkin bread calls for $2\frac{2}{3}$ cups of pumpkin and $3\frac{1}{4}$ cups of flour. How many more cups of flour are needed than pumpkin?

Example 7

Find $6\frac{5}{8} - 2\frac{2}{5}$. **Estimate** $7 - 2 = 5$

$$6\frac{5}{8} \rightarrow \frac{5 \times 5}{8 \times 5} \rightarrow 6\frac{25}{40}$$
$$-2\frac{2}{5} \rightarrow \frac{2 \times 8}{5 \times 8} \rightarrow -2\frac{16}{40}$$
$$\overline{\phantom{-2\frac{2}{5}} \qquad \qquad \qquad \quad 4\frac{9}{40}}$$

Example 8

Find $3\frac{1}{5} - 1\frac{4}{5}$. **Estimate** $3 - 2 = 1$

$$3\frac{1}{5} \rightarrow 2\frac{6}{5} \quad \text{Rename } 3\frac{1}{5} \text{ as } 2\frac{6}{5}.$$
$$-1\frac{4}{5} \rightarrow -1\frac{4}{5}$$
$$\overline{\phantom{-1\frac{4}{5}} \qquad \quad 1\frac{2}{5}}$$

5-6

6.1.6,
P.6.1

Estimating Products of Fractions (pp. 276–279)

Estimate each product.

45. $\frac{1}{5} \times 21$

46. $10 \times 2\frac{3}{4}$

47. $\frac{5}{6} \times 13$

48. $7\frac{3}{4} \times \frac{1}{4}$

49. $4\frac{5}{6} \times 8\frac{3}{10}$

50. $\frac{3}{7} \times \frac{11}{12}$

51. **AMUSEMENT PARKS** The average wait time to ride the Super Coaster is 55 minutes. If Joy and her friends have waited $\frac{5}{6}$ of that time, estimate how long they have waited.

Example 9 Estimate $\frac{1}{7} \times 41$.

$\frac{1}{7} \times 41 \rightarrow \frac{1}{7} \times 42$ 42 and 7 are compatible numbers since $42 \div 7 = 6$.

$\frac{1}{7} \times 42 = 6$ $\frac{1}{7}$ of 42 is 6.

So, $\frac{1}{7} \times 41$ is *about* 6.

5-7 | **Multiplying Fractions** (pp. 282–286)

6.1.6

Multiply. Write in simplest form.

52. $\frac{1}{3} \times \frac{1}{4}$ 53. $\frac{7}{8} \times \frac{4}{21}$ 54. $\frac{5}{6} \times 9$

55. **SCHOOL** Half of Mr. Carson's class play a sport. Of these, two thirds are male. What fraction of the class is male and play a sport?

Example 10 Find $\frac{3}{10} \times \frac{4}{9}$.

$$\frac{3}{10} \times \frac{4}{9} = \frac{\overset{1}{\cancel{3}} \cdot \overset{2}{\cancel{4}}}{\underset{5}{\cancel{10}} \cdot \underset{3}{\cancel{9}}} \quad \text{Divide the numerator and denominator by the GCF.}$$

$$= \frac{2}{15} \quad \text{Simplify.}$$

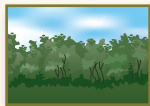**5-8** | **Multiplying Mixed Numbers** (pp. 287–290)

6.1.6

Multiply. Write in simplest form.

56. $\frac{2}{3} \times 4\frac{1}{2}$ 57. $6\frac{5}{8} \times 4$ 58. $2\frac{1}{4} \times 6\frac{2}{3}$

59. **ART** Find the area of the painting.

$2\frac{3}{4}$ ft

$4\frac{2}{3}$ ft

Example 11 Find $3\frac{1}{2} \times 4\frac{2}{3}$.

$$3\frac{1}{2} \times 4\frac{2}{3} = \frac{7}{2} \times \frac{14}{3} \quad \text{Write the numbers as improper fractions.}$$

$$= \frac{7}{\underset{1}{\cancel{2}}} \times \frac{\overset{7}{\cancel{14}}}{3} \quad \text{Divide 2 and 14 by their GCF, 2.}$$

$$= \frac{49}{3} \text{ or } 16\frac{1}{3} \quad \text{Simplify.}$$

5-9 | **Dividing Fractions** (pp. 293–297)

6.1.6

Divide. Write in simplest form.

60. $\frac{2}{3} \div \frac{4}{5}$ 61. $\frac{1}{8} \div \frac{3}{4}$ 62. $5 \div \frac{4}{9}$

63. **COOKING** Ashanti uses $\frac{3}{4}$ cup of oats to make cookies. This is $\frac{1}{3}$ the amount called for in the recipe. How many cups of oats are called for in the recipe?

Example 12 Find $\frac{3}{8} \div \frac{2}{3}$.

$$\frac{3}{8} \div \frac{2}{3} = \frac{3}{8} \times \frac{3}{2} \quad \text{Multiply by the reciprocal of } \frac{2}{3}.$$

$$= \frac{9}{16} \quad \text{Multiply the numerators and multiply the denominators.}$$

5-10 | **Dividing Mixed Numbers** (pp. 298–301)

6.1.6

Divide. Write in simplest form.

64. $2\frac{4}{5} \div 5\frac{3}{5}$ 65. $8 \div 2\frac{1}{2}$

66. **ICE CREAM** To make $4\frac{1}{2}$ gallons of ice cream, it takes $6\frac{3}{10}$ gallons of milk. How many gallons of milk does it take to make one gallon of ice cream?

Example 13 Find $5\frac{1}{2} \div 1\frac{5}{6}$.

$$5\frac{1}{2} \div 1\frac{5}{6} = \frac{11}{2} \div \frac{11}{6} \quad \text{Rewrite as improper fractions.}$$

$$= \frac{11}{2} \times \frac{6}{11} \quad \text{Multiply by the reciprocal.}$$

$$= \frac{\overset{1}{\cancel{11}}}{\underset{1}{\cancel{2}}} \times \frac{\overset{3}{\cancel{6}}}{\underset{1}{\cancel{11}}} \quad \text{Divide by the GCF.}$$

$$= \frac{3}{1} \text{ or } 3 \quad \text{Simplify.}$$

Round each number to the nearest half.

1. $4\frac{7}{8}$

2. $1\frac{10}{18}$

3. $11\frac{1}{17}$

4. **TRACK** For a 3-person relay race, a coach can choose from 4 of his top runners. How many different 3-person teams can he choose? Use the *act it out* strategy.

5. **MULTIPLE CHOICE** The table shows the amount of rainfall over a one-week period in May. It did not rain on any other days of the week. Find the total amount of rainfall for the week.

Day of Week	Rainfall (in.)
Monday	$1\frac{1}{4}$
Thursday	$\frac{5}{8}$
Saturday	$1\frac{5}{16}$

   A $2\frac{3}{16}$ in.

   B $2\frac{5}{16}$ in.

   C $3\frac{3}{16}$ in.

   D $3\frac{5}{16}$ in.

Add or subtract. Write in simplest form.

6. $\frac{2}{9} + \frac{5}{9}$

7. $\frac{11}{12} - \frac{3}{8}$

8. $\frac{2}{5} + \frac{2}{4}$

9. **CAKES** At a party, if $\frac{1}{3}$ of one sheet cake and $\frac{1}{6}$ of another sheet cake remain uneaten, what fraction of a whole sheet cake remains uneaten?

Add or subtract. Write in simplest form.

10. $2\frac{1}{5} + 4\frac{2}{5}$

11. $6\frac{5}{8} - 4\frac{1}{2}$

12. $11\frac{1}{2} - 7\frac{3}{5}$

13. **MULTIPLE CHOICE** If you use $1\frac{1}{4}$ pounds of a 3-pound package of ground beef and freeze the rest, how much ground beef do you freeze?

   F $2\frac{3}{4}$ lb

   H $1\frac{1}{4}$ lb

   G $1\frac{3}{4}$ lb

   J $\frac{3}{4}$ lb

Estimate each product.

14. $\frac{1}{3} \times 22$

15. $3\frac{2}{3} \times 5\frac{1}{9}$

16. $\frac{7}{8} \times 39$

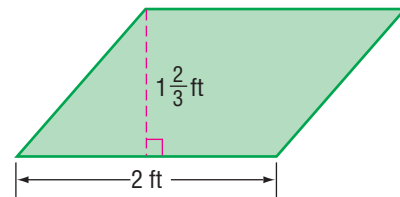17. $6\frac{4}{5} \times 8\frac{1}{7}$

Multiply. Write in simplest form.

18. $\frac{3}{5} \times \frac{2}{9}$

19. $\frac{3}{8} \times 2\frac{2}{3}$

20. $7\frac{7}{8} \times 5\frac{1}{3}$

21. **GEOMETRY** To find the area of a parallelogram, use the formula $A = bh$, where b is the length of the base and h is the height. Find the area of the parallelogram.

$1\frac{2}{3}$ ft
2 ft

Divide. Write in simplest form.

22. $\frac{1}{8} \div \frac{3}{4}$

23. $\frac{2}{5} \div 4$

24. $5\frac{3}{4} \div 1\frac{1}{2}$

25. **ALGEBRA** Evaluate $x \div y$ if $x = 7\frac{2}{3}$ and $y = 1\frac{4}{5}$. Write in simplest form.

PART 1   Multiple Choice

Read each question. Then fill in the correct answer on the answer sheet provided by your teacher or on a sheet of paper.

1. Ted is going to make three different picture frames. He will need $3\frac{1}{4}$ feet of wood for the first frame, $1\frac{2}{3}$ feet of wood for the second frame, and $2\frac{1}{2}$ feet of wood for the third frame. How much wood does Ted need for all three picture frames?

   A $6\frac{3}{4}$ feet   **C** $7\frac{5}{12}$ feet

   B $7\frac{7}{8}$ feet   **D** $8\frac{1}{2}$ feet

2. Trevor plans to buy rope for two projects. One project requires $\frac{5}{8}$ yard of rope, and the other requires $\frac{1}{4}$ yard of rope. Each strip below represents 1 yard of rope. Which strip is shaded to show the total amount of rope that Trevor needs for both projects?

   F
   G
   H
   J

3. Two-thirds of a blueberry pie is left in the refrigerator. If the pie is cut in 6 equal-size slices, what fraction of the original pie is each slice?

   A $\frac{1}{9}$ **C** $\frac{1}{4}$

   B $\frac{1}{6}$ **D** $\frac{1}{3}$

4. Annmarie bought two DVDs that were originally priced at $19 each. Each DVD was on sale for $5 off the original price of the DVD. Which equation could be used to find c, the total sale price of the 2 DVDs?

   F $c = 2(19) - 2(5)$

   G $c = 2(19) - 5$

   H $c = 19 - 2(5)$

   J $c = 19 - 5$

5. Keith shipped a present to his mom in a box that has a length of 9.5 inches. The width of the box is 3.4 inches less than the length. What is the width of the box?

   A 12.9 in.   **C** 6.1 in.

   B 6.9 in.   **D** 5.1 in.

TEST-TAKING TIP

Question 5 You can use number sense to eliminate possible answer choices. You know that the width is *less* than the length. So, eliminate answer choice A.

6. At Medina Middle School there are 53 homerooms. If 955 students attend Medina Middle School, about how many students are in each homeroom?

   F 17   **H** 19

   G 18   **J** 20

7. Estimate the amount of money needed to pay for the groceries shown in the table.

Shopping List	
Cereal	$2.89
Meats	$7.75
Lettuce	$1.29
Detergent	$5.89

   A $21   **C** $19

   B $20   **D** $18

8. Jordan ran $2\frac{3}{4}$ miles on Monday. On Wednesday, he ran twice as many miles than he did on Monday. On Friday, Jordan ran $1\frac{1}{2}$ times as many miles than he did on Wednesday. How many miles did he run on Friday?

   F $8\frac{3}{4}$ miles

   G $8\frac{1}{4}$ miles

   H $6\frac{1}{2}$ miles

   J $5\frac{3}{4}$ miles

9. Evelyn must buy plastic bowls and plastic spoons for an ice cream party. Bowls are sold in packages of 16 and spoons in packages of 24. What is the least number of packages of bowls and spoons that Evelyn can buy to have an equal number of bowls and spoons?

   A 5 packages of bowls and 3 packages of spoons

   B 2 packages of bowls and 3 packages of spoons

   C 3 packages of bowls and 2 packages of spoons

   D 4 packages of bowls and 4 packages of spoons

10. Drew read 120 pages of his book, which was $\frac{3}{5}$ of the book. What decimal represents the fraction that he has read?

    F 0.12   **H** 0.60

   **G** 0.35   **J** 0.80

PART 2   Short Response/Grid In

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

11. Mr. Thompson recorded these geography quiz scores: 23, 21, 19, 25, 24, 15, 18, 19, and 23. What is the median of these quiz scores?

12. Lamar recorded his times for several 100-meter dash trials in seconds. Which was the fastest time in seconds?

    8.9 s, 8.64 s, 8.45 s, 8.5 s, 8.42 s

PART 3   Extended Response

Record your answers on the answer sheet provided by your teacher or on a sheet of paper. Show your work.

13. Misha planted a tomato garden with the following dimensions.
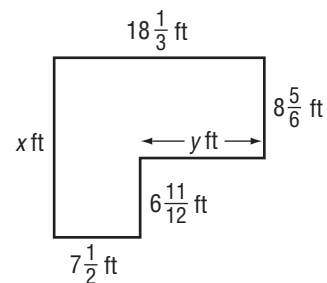
   a. Find the value of x as a fraction in simplest form.

   b. Find the value of y as a fraction in simplest form.

   c. Misha wishes to enclose the garden with a fence. How many feet of fencing would be needed to enclose the entire garden? Write as a fraction in simplest form.

NEED EXTRA HELP?												
If You Missed Question...	1	2	3	4	5	6	7	8	9	10	11	12	13
Go to Lesson...	5-5	5-4	1-3	1-8	3-5	3-3	3-4	4-6	4-5	4-8	2-7	3-2	5-5
IN Academic Standards	6.1.6	6.1.6	7.1.3	6.2.1	6.1.6	6.1.6	6.1.6	6.1.1	6.1.6	6.1.4	6.4.3	6.1.1	6.1.6