Chapter 2

Multiply and Divide Fractions

Essential Question

WHAT does it mean to multiply and divide fractions?

Common Core GPS

Content Standards
MCC6.NS.1, MCC6.RP.3, MCC6.RP.3d

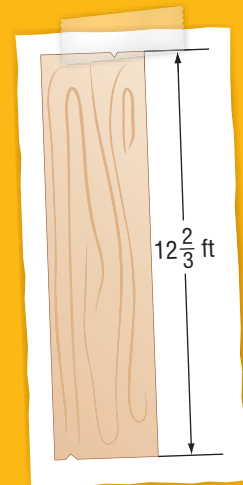**Mathematical Practices**
1, 2, 3, 4, 5, 6, 7, 8

Math in the Real World

Construction Builders measure using fractions and convert measurements between different units.

A $12\frac{2}{3}$-foot board needs to be divided into 19-inch pieces. On the board below, make the divisions to show the number of pieces.

$12\frac{2}{3}$ ft

FOLDABLES® Study Organizer

1 Cut out the correct Foldable from the FL pages in the back of this book.

2 Place your Foldable on the Key Concept page toward the end of this chapter.

3 Use the Foldable throughout this chapter to help you learn about multiplying and dividing fractions.

What Tools Do You Need?

Vocabulary

Commutative Property   least common multiple

dimensional analysis   reciprocals

greatest common factor   unit ratio

Study Skill: Writing Math

Explain Your Answer When you explain your answer, you give reasons why your answer is correct.

Sal wants to buy 5 packages of the limited edition cards. Is $20 enough for 5 packages, or does Sal need to bring $25 to the store to buy them? Explain your answer.

Football Card Prices	
Package	**Price ($)**
All-Star	3.75
Limited Edition	4.59
Deluxe	5.99

Step 1 Estimate.

$5 \times \$4 =$ _____   Round down.

$5 \times \$5 =$ _____   Round up.

Step 2 Answer the question.

Sal should bring _____ to the store.

Step 3 Explain why. Write your explanation in complete sentences.

Using the estimate, Sal knows that the actual cost is between _____

and _____. So _____ is not enough.

Practice explaining your answer.

1. Marta plans to buy 2 baseballs and 1 baseball glove. Is $50 enough to bring to the store or does Marta need to bring $55? Explain your answer. _____

_____

_____

_____

THE SPORTS COVE

Baseball............ 6.50
Baseball
glove...............37.99
Baseball
cap.................13.79

Are You Ready?

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

Check ✓

Quick Review

CCGPS **Common Core Review** MCC5.NF.1, MCC5.NF.2

Example 1

Estimate $4\frac{5}{6} + 1\frac{1}{8}$.

Think: $\frac{5}{6} > \frac{1}{2}$.
So, $4\frac{4}{6}$ rounds to 5.

$4\frac{5}{6} + 1\frac{1}{8}$

Think: $\frac{1}{8} < \frac{1}{2}$.
So, $1\frac{1}{8}$ rounds to 1.

$5 + 1 = 6$

So, $4\frac{5}{6} + 1\frac{1}{8}$ is about 6.

Example 2

Add $5\frac{9}{10} + 3\frac{3}{4}$. Write in simplest form.

$5\frac{9}{10} \rightarrow 5\frac{18}{20}$

Rename the fractions using the LCD, 20.

$+ 3\frac{3}{4} \rightarrow 3\frac{15}{20}$

$8\frac{33}{20}$ or $9\frac{13}{20}$

So, $5\frac{9}{10} + 3\frac{3}{4}$ is equal to $9\frac{13}{20}$.

Quick Check

Estimate with Fractions Estimate each sum or difference.

1. $6\frac{7}{8} + 5\frac{1}{4} \approx$ _____

2. $3\frac{1}{7} + 8\frac{1}{9} \approx$ _____

3. $12\frac{1}{5} - 5\frac{5}{6} \approx$ _____

Show your work.

Add and Subtract Fractions Add or subtract. Write in simplest form.

4. $\frac{9}{10} + \frac{3}{5} =$ _____

5. $7\frac{2}{3} - 3\frac{1}{7} =$ _____

6. $9\frac{7}{8} - 2\frac{5}{6} =$ _____

7. Suppose a plant grew $4\frac{1}{2}$ inches one week and $2\frac{3}{8}$ inches the next week.

How many inches did it grow during both weeks?

_____

How Did You Do?

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

1 2 3 4 5 6 7

Estimate Products of Fractions

What You'll Learn

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

- _____
  _____

- _____
  _____

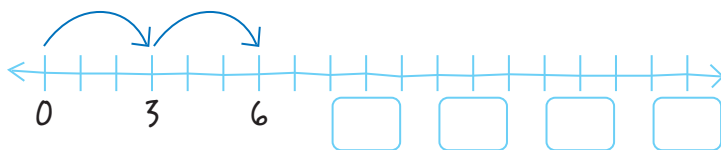## Real-World Link

Watch   Tools

Nature A wildlife preserve has 16 tigers, about $\frac{1}{3}$ of which are male. The tigers are represented by the counters below.
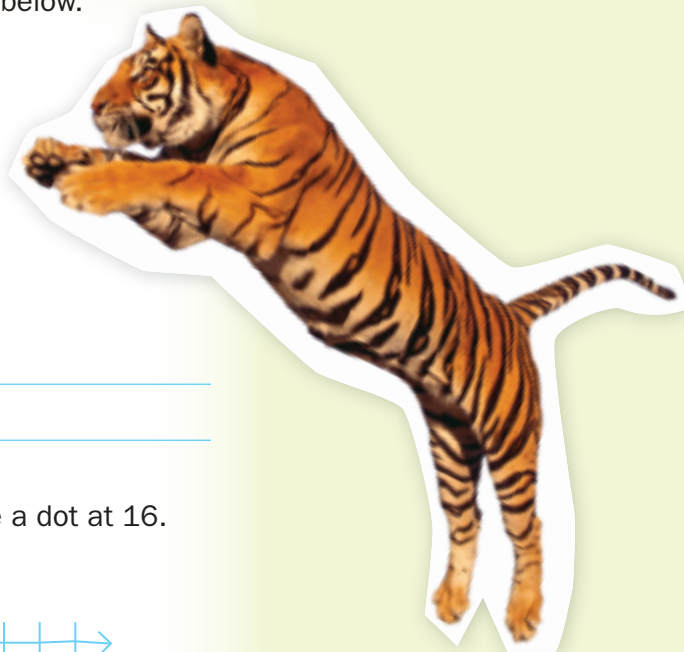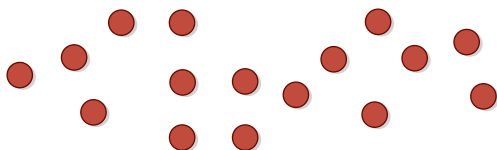
1. Can you separate the counters into three equal groups? Explain.

   _____

   _____

2. Fill in the multiples of 3 on the number line. Place a dot at 16.

   0   3   6   ☐   ☐   ☐   ☐

3. What multiple of 3 is closest to 16? ☐

4. Arrows jump from 0 to 3 to 6. Continue the pattern. How many jumps are from 0 to your answer in Exercise 3? ☐ jumps

5. About how many tigers in the preserve are male? Explain.

   _____

Estimate Using Compatible Numbers

You have already used compatible numbers to estimate quotients. You can also use compatible numbers to estimate products.
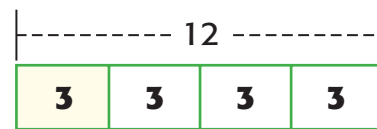
Examples

Tutor

1. **Estimate $\frac{1}{4} \times 13$.**

Find a multiple of 4 close to 13. 12 and 4 are compatible numbers since $12 \div 4 = 3$.

Method 1 **Use a model.**

Divide the bar representing 12 into 4 sections.

Each section is $\frac{1}{4}$ of 12, or 3.

Label each section 3.

	12		
3	3	3	3

Method 2 **Use compatible numbers.**

$\frac{1}{4} \times 13 \approx \frac{1}{4} \times 12$

$\qquad \approx 3$

So, $\frac{1}{4} \times 13$ *is about* 3.

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯

2. **Estimate $\frac{2}{5}$ of 11.**

Find a multiple of 5 close to 11. 10 and 5 are compatible numbers since $10 \div 5 = 2$.

$\frac{1}{5} \times 11 \approx \frac{1}{5} \times 10$

$\qquad \approx 2$

If $\frac{1}{5}$ of 10 is 2, then

$\frac{2}{5}$ of 10 is 2×2, or $\boxed{}$.

So, $\frac{2}{5} \times 11$ *is about* $\boxed{}$.

	10	

Compatible Numbers

Use compatible numbers to estimate the product of a fraction and a whole number. Find compatible numbers using the denominator of the fraction and the whole number.
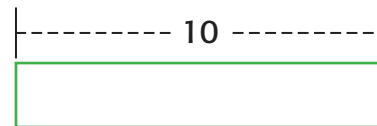
Show your work.

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

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

a. _____

b. _____

c. _____

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

Words   If the numerator of a fraction between 0 and 1 is almost as large as the denominator, round up. If the numerator is much smaller than the denominator, round down.

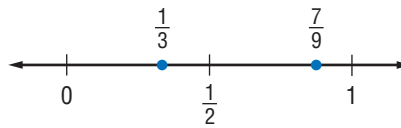**Examples** $\frac{7}{8}$ rounds to 1; $\frac{1}{8}$ rounds to 0

Rounding fractions can help you find products of fraction factors.

Examples

Tutor

3. Estimate $\frac{1}{3} \times \frac{7}{9}$.

Dots are placed at $\frac{1}{3}$ and $\frac{7}{9}$.

Round to 0, $\frac{1}{2}$, or 1. $\frac{1}{3}$ is about $\frac{1}{2}$ and $\frac{7}{9}$ is about 1.
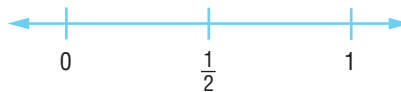
$\frac{1}{3} \times \frac{7}{9}$ → $\frac{1}{2} \times 1$

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

So, $\frac{1}{3} \times \frac{7}{9}$ is about $\frac{1}{2}$.

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

Place dots on the number line at $\frac{1}{9}$ and $\frac{4}{5}$.

Round to 0, $\frac{1}{2}$, or 1. $\frac{1}{9}$ is about 0 and $\frac{4}{5}$ is about 1.

$\frac{1}{9} \times \frac{4}{5}$ → $0 \times 1 = \boxed{}$

So, $\frac{1}{9} \times \frac{4}{5}$ is about $\boxed{}$.

Got It?   Do these problems to find out.

Estimate each product.

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

Show your work.

d. _____

e. _____

f. _____

Real World Example

5. **Estimate the area of the flower bed.**

Round each mixed number to the nearest whole number.

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

So, the area *is about* 90 square feet.

$6\frac{1}{8}$ ft

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

Guided Practice

Check ✓

Estimate each product. Use a bar diagram if needed. (Examples 1–4)

1. $\frac{1}{8} \times 15 \approx$ _____

2. $\frac{2}{5}$ of $26 \approx$ _____

Show your work.

3. $\frac{1}{5} \times \frac{8}{9} \approx$ _____

4. $6\frac{2}{3} \times 4\frac{1}{5} \approx$ _____

5. A border is made of $32\frac{2}{3}$ bricks that are $1\frac{1}{6}$ feet long. About how long is the border? (Example 5)

_____

_____

6. A kitchen measures $24\frac{1}{6}$ feet by $9\frac{2}{3}$ feet. Estimate the area of the kitchen. (Example 5)

_____

_____

7. ⓔ **Building on the Essential Question** Why is estimating products of fractions useful? _____

_____

_____

Rate Yourself!

How confident are you about estimating the products of fractions? Color the square that applies.

☹ 😐 🙂

☐ ☐ ☐ ☐ ☐

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

Tutor

Independent Practice

eHelp

Estimate each product. Use a bar diagram if needed. (Examples 1–4)

1. $\frac{1}{4} \times 21 \approx$ _____

Show your work.

2. $\frac{5}{7}$ of $22 \approx$ _____

3. $\frac{5}{7} \times \frac{1}{9} \approx$ _____

4. $4\frac{1}{3} \times 2\frac{3}{4} \approx$ _____

5 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? (Example 5)

_____

6. Hakeem's front porch measures $9\frac{3}{4}$ feet by 4 feet. Estimate the area of his front porch. (Example 5)

_____

7. CCSS **Use Math Tools** Refer to the graphic novel frame for Exercises a–b.

Watch ▷ Replay it online!
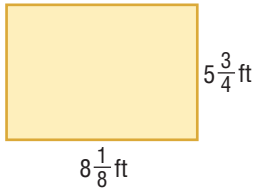
I hope 5 bags is enough.

a. If each bag holds $3\frac{3}{4}$ pounds, estimate how many pounds of birdseed Elisa, Luis, and Dwayne purchased. _____

_____

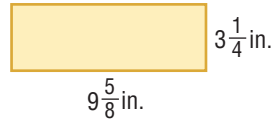**b.** Suppose each bag costs $14.99. Estimate the total cost of 5 bags.

_____

Estimate the area of each rectangle.

8.

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

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

9

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

$9\frac{5}{8}$ in.

10. **STEM** 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 *not* rain in 90 days? _____

_____

_____

🔥 H.O.T. Problems   **H**igher **O**rder **T**hinking

11. **CCSS** **Justify Conclusions** By what fraction would you multiply $8\frac{1}{2}$ so that the product is about 5? Explain your reasoning. _____

_____

_____

12. **CCSS** **Persevere with Problems** Determine which point on the number line could be the graph of the product of the numbers graphed at *C* and *D*.

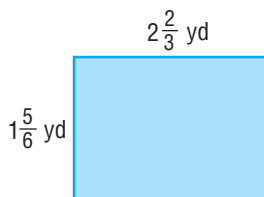0   *M*   *N C R D*   1

Explain your reasoning. _____

_____

_____

✏️ Georgia Test Practice

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

Ⓐ 2 yd²
Ⓑ 3 yd²
Ⓒ 6 yd²
Ⓓ 10 yd²

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

$1\frac{5}{6}$ yd

Extra Practice

Estimate each product. Use a bar diagram if needed.

14. $\frac{1}{5} \times 26 \approx$ ___5___

Homework Help ➡

$26 \approx 25; \frac{1}{\cancel{5}} \times \cancel{25}^{5} = \frac{5}{1}$ or 5

15. $\frac{1}{3}$ of $41 \approx$ ___14___

$41 \approx 42; \frac{1}{\cancel{3}} \times \cancel{42}^{14} = \frac{14}{1}$ or 14

16. $\frac{1}{6}$ of $17 \approx$ _____
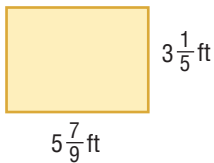
17. $\frac{2}{9}$ of $88 \approx$ _____

18. $\frac{2}{3} \times 10 \approx$ _____

19. $\frac{3}{8} \times 4 \approx$ _____

Estimate the area of the each rectangle.

20. _____

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

$5\frac{7}{9}$ ft

21. _____

$1\frac{1}{3}$ cm

$7\frac{7}{8}$ cm
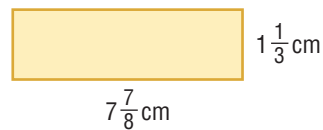
22. Tara would like to finish $\frac{2}{5}$ of her book by next Friday. If the book has 203 pages, about how many pages does she need to read? _____

_____

23. Javier is organizing his movie collection. He discovers that $\frac{5}{8}$ of his movies are action movies. If he has 46 movies, about how many are action movies? _____

_____

24. **CCGPS** **Justify Conclusions** Marco has a collection of 38 state quarters. If $\frac{3}{5}$ of his quarters are dated 2005, what is the approximate value of the quarters from 2005? Explain your answer to a classmate.

_____

25. The table shows the number of students in grades 6–8 who 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?

Students Visiting the Museum	
Grade	Number of Students
6	45
7	48
8	40

- Ⓐ Less than 65
- Ⓑ Between 65 and 100
- Ⓒ Between 100 and 130
- Ⓓ More than 130

26. According to a survey, $\frac{3}{5}$ of the students prefer outdoor activities after school. If 63 students were surveyed, about how many would prefer playing sports outdoors?

- Ⓕ 24 students
- Ⓖ 30 students
- Ⓗ 36 students
- Ⓘ 48 students

27. In Mrs. Petrocelli's class, $\frac{5}{7}$ of the students are wearing jeans today. If there are about 27 students in her class, how many students are wearing jeans today?

- Ⓐ 4 students
- Ⓑ 8 students
- Ⓒ 20 students
- Ⓓ 24 students

28. **Short Response** A drawing of a square room is shown. Estimate the area in square feet of tile needed to cover the floor.

$10\frac{5}{6}$ ft

_____

Round each fraction to 0, $\frac{1}{2}$, or 1. MCC4.NF.2

29. $\frac{7}{12} \approx$ _____

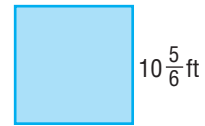**30.** $\frac{5}{6} \approx$ _____

31. $\frac{2}{11} \approx$ _____

32. $\frac{4}{9} \approx$ _____

33. Graph $\frac{3}{4}, \frac{1}{3}, \frac{1}{4},$ and $\frac{2}{3}$. MCC4.NF.2

```
<---+-------+-------+--->
    0      1/2      1
```

34. Graph $\frac{5}{10}, \frac{4}{5}, \frac{2}{5},$ and $\frac{7}{10}$. MCC4.NF.2

```
<---+-------+-------+--->
    0      1/2      1
```

35. Jasper wants to paint one wall of his room. If the wall is 12 feet wide and 10 feet tall, what is the area of the wall? MCC4.MD.3 _____

Multiply Fractions and Whole Numbers

What You'll Learn

Scan the lesson. Predict two things you will learn about multiplying fractions and whole numbers.

- _____
  _____

- _____
  _____

Essential Question

WHAT does it mean to multiply and divide fractions?

Vocab

Vocabulary

Commutative Property

Common Core GPS

Content Standards
MCC5.NF.6, Preparation for MCC6.NS.1

Mathematical Practices
1, 3, 4, 7

Vocabulary Start-Up

A commuter train travels back and forth but does not change the distance traveled. In mathematics, operations that follow the **Commutative Property** can be performed in any order. For example, addition and multiplication are commutative.

Draw a line to "Commutative" if the examples can be done in either order. Draw a line to "Not Commutative" if the order changes the outcome.

$12 \div 6; 6 \div 12$

tying your left shoe; tying your right shoe

Commutative

$5 \times 7; 7 \times 5$

Not Commutative

play a soccer game; change into your team uniform

$15 + 5; 5 + 15$

Real-World Link

Some morning routines can be done in any order. Sometimes, the order matters. Describe a situation when the order you perform two actions is important.

_____

_____

Multiply a Whole Number by a Fraction

Words   Write the whole number as a fraction. Multiply the numerators and multiply the denominators.

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

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

$= \dfrac{15}{4}$ or $3\dfrac{3}{4}$ Simplify.

Example

Tutor

1. Find $2 \times \dfrac{2}{5}$.

Method 1   Use an area model.

Shade $\dfrac{2}{5}$ of each of the first two columns.

A total of $\dfrac{4}{5}$ has been shaded.

Shade $\dfrac{4}{5}$ on the third column.

Method 2   Use an equation.

Estimate $2 \times \dfrac{1}{2} = 1$

$2 \times \dfrac{2}{5} = \blacksquare$

$2 \times \dfrac{2}{5} = \dfrac{2}{1} \times \dfrac{2}{5}$ Write 2 as $\dfrac{2}{1}$.

$= \dfrac{2 \times 2}{1 \times 5}$ Multiply.

$= \dfrac{4}{5}$ Simplify.

Using either method, $2 \times \dfrac{2}{5}$ is $\dfrac{4}{5}$.

Check for Reasonableness $\dfrac{4}{5} \approx 1$ ✔

Show your work.

Got It?   Do these problems to find out.

a. $6 \times \dfrac{2}{3}$ **b.** $9 \times \dfrac{1}{3}$ **c.** $4 \times \dfrac{1}{8}$

a. _____

b. _____

c. _____

Multiply a Fraction by a Whole Number

When multiplying whole numbers and fractions, the order of the factors does not change the product. So, $4 \times \frac{3}{5} = \frac{3}{5} \times 4$. This is an example of the Commutative Property.

Examples

Tutor

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

Method 1 Use an area model.

Shade $\frac{3}{5}$ of each of the 4 columns.

A total of $\frac{12}{5}$ or $2\frac{2}{5}$ has been shaded.

$\frac{3}{5}$ {

4

Method 2 Use an equation. Estimate $\frac{1}{2} \times 4 = 2$

$\frac{3}{5} \times 4 = \blacksquare$

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

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

$\quad = \frac{12}{5}$ Simplify. Compare to the estimate.

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

Using either method, $\frac{3}{5} \times 4$ is $2\frac{2}{5}$.

3. Find $\frac{1}{4} \times 5$.

Estimate $\frac{1}{4} \times 4 = 1$

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

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

$\quad = \frac{5}{4}$ or $1\frac{1}{4}$ Simplify.
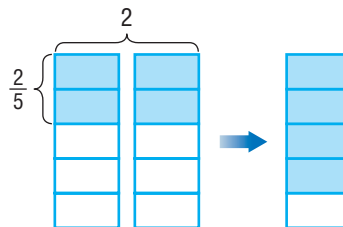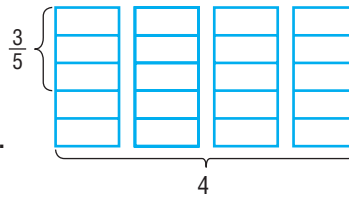
Check for Reasonableness $1\frac{1}{4} \approx 1$ ✔

Got It? Do these problems to find out.

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

Renaming

To rename an improper fraction as a mixed number, divide the numerator by the denominator. Write the remainder as a fraction with the divisor as the denominator.

Show your work.

d. _____

e. _____

f. _____

Real World Example

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

Find $\frac{4}{5}$ of 28.   Estimate $\frac{4}{5}$ of 30 is 24.

$\frac{4}{5} \times 28 = \frac{4}{5} \times \frac{28}{1}$ Write 28 as $\frac{28}{1}$.

$\phantom{\frac{4}{5} \times 28} = \frac{4 \times 28}{5 \times 1}$ Multiply.

$\phantom{\frac{4}{5} \times 28} = \frac{112}{5}$ or $22\frac{2}{5}$ Simplify. Compare to the estimate.

A sloth spends $22\frac{2}{5}$ years of its life asleep.

Guided Practice

Multiply. Write in simplest form. (Examples 1–3)

1. $10 \times \frac{4}{5} =$ _____

Show your work.

2. $2 \times \frac{3}{4} =$ _____

3. $\frac{3}{8} \times 11 =$ _____

4. $\frac{3}{7} \times 9 =$ _____

5. A cat spends $\frac{2}{3}$ of its life asleep. If a cat lives to be 15 years old, how many years did it spend asleep? (Example 4) _____

6. **(Q)** **Building on the Essential Question** How is the process used to multiply a fraction and a whole number similar to the process used to multiply two whole numbers?

_____

_____

_____

_____

Rate Yourself!

Are you ready to move on? Shade the section that applies.
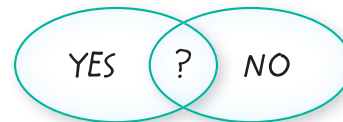
YES   ?   NO

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

Tutor

FOLDABLES *Time to update your Foldable!*

Independent Practice

Multiply. Write in simplest form. (Examples 1–3)

1. $20 \times \dfrac{3}{4} =$ _____

2. $14 \times \dfrac{2}{7} =$ _____
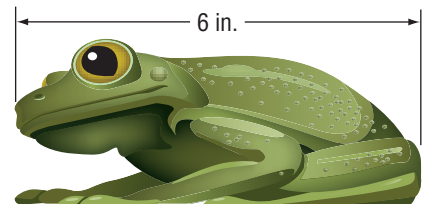
3. $10 \times \dfrac{1}{5} =$ _____

Show your work.

4. $\dfrac{3}{4} \times 6 =$ _____

5. $\dfrac{2}{5} \times 11 =$ _____

6. $\dfrac{1}{4} \times 6 =$ _____

7 **STEM** The male Cuban tree frog is about $\dfrac{2}{5}$ 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? (Example 4) _____

— 6 in. —

8. The Mississippi River is the second longest river in the United States, second only to the Missouri River. The Mississippi River is about $\dfrac{23}{25}$ the length of the Missouri River. If the Missouri River is 2,540 miles long, how long is the Mississippi River? (Example 4)

_____

_____

9 One evening, $\dfrac{2}{3}$ of Mrs. Thorne's students watched a reality television show. Of Mrs. Lombardo's students, $\dfrac{4}{5}$ watched the same reality show. Which teacher had more students that watched the reality show? Explain.

_____

_____

Teacher	Number of Students
Mrs. Thorne	36
Mrs. Lombardo	30
Mr. Hollern	28

10. **CCSS** **Persevere with Problems** The table shows where sixth grade students at Sharonton Middle School attended fifth grade. There are 156 sixth grade students. How many more students attended Sharonton Elementary than Deacon Elementary?

_____

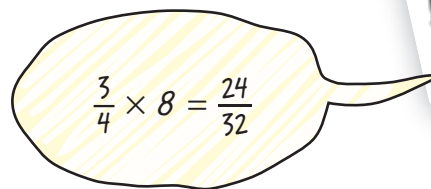| School	Fraction of Students
Sharonton Elementary	$\dfrac{1}{2}$
Deacon Elementary	$\dfrac{1}{4}$
Banyon Elementary	$\dfrac{1}{6}$
New Students	$\dfrac{1}{12}$

11. **CCGPS** **Persevere with Problems** Students at Marzo Middle School were recently surveyed. The results reported $\frac{1}{4}$ of sixth grade students, $\frac{3}{10}$ of seventh grade students, and $\frac{2}{7}$ of eighth grade students plan a career in STEM. In which grade do the most students plan to have careers in STEM?

Grade	Total Students
6	152
7	160
8	147

_____

_____

H.O.T. Problems   Higher Order Thinking

12. **CCGPS** **Identify Structure** Write a problem involving the multiplication of a fraction and a whole number with a product that is between 8 and 10.

_____

_____

13. **CCGPS** **Find the Error** Noah is finding $\frac{3}{4}$ of 8. Find his mistake and correct it.

_____

_____

_____

_____

$$\frac{3}{4} \times 8 = \frac{24}{32}$$

14. **CCGPS** **Persevere with Problems** Use the digits 2, 3, and 5 to create a fraction and a whole number with a product greater than 2.

_____

_____

Georgia Test Practice

15. Jenny made five loaves of banana bread that had $\frac{1}{4}$ cup of oil in each loaf. How many cups of oil were used in all?

Ⓐ 5

Ⓑ 4

Ⓒ $1\frac{1}{4}$

Ⓓ $\frac{3}{4}$

Extra Practice

Multiply. Write in simplest form.

16. $12 \times \frac{1}{3} =$ __4__

$$\frac{\overset{4}{\cancel{12}}}{1} \times \frac{1}{\cancel{3}_1} = \frac{4}{1} \text{ or } 4$$

Homework Help

17. $18 \times \frac{1}{3} =$ __6__

$$\frac{\overset{6}{\cancel{18}}}{1} \times \frac{1}{\cancel{3}_1} = \frac{6}{1} \text{ or } 6$$

18. $8 \times \frac{1}{4} =$ _____

19. $\frac{1}{5} \times 7 =$ _____

20. $\frac{3}{7} \times 8 =$ _____

21. $\frac{5}{6} \times 15 =$ _____

22. For a singing contest in which 42,000 votes were cast, the winner received $\frac{3}{5}$ of the votes. How many votes did the winner *not* receive?

_____

Show your work.

23. **STEM** 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?

_____

24. **CCSS** **Model with Mathematics** Write a real-world problem that involves multiplying a fraction and a whole number. Solve the problem and use estimation to check for reasonableness.

_____

_____

25. Leonard used $\frac{2}{7}$ of his paycheck to pay his cell phone bill. How much was Leonard's cell phone bill?

| Pay to the order of	1438
Leonard White	$63.00
Leonard White	1438
Time	Net Pay
10 hours	$63.00

Ⓐ $12   Ⓒ $27

Ⓑ $18   Ⓓ $36

26. 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?

Ⓕ 3   Ⓗ 27

Ⓖ 18   Ⓘ 72

27. Short Response It takes $\frac{3}{8}$ yards of fabric to make a blanket. How many yards of fabric will it take to make 16 blankets?

_____

_____

28. David made 10 batches of muffins. He used $\frac{2}{3}$ cup of milk in each batch. How much milk did David use?

Ⓐ 6 cups

Ⓑ $6\frac{1}{3}$ cups

Ⓒ $6\frac{2}{3}$ cups

Ⓓ 20 cups
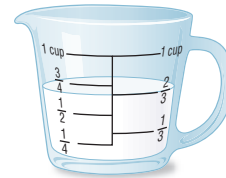
Multiply. MCC5.NBT.5.

29. $22 \times 13 =$ _____
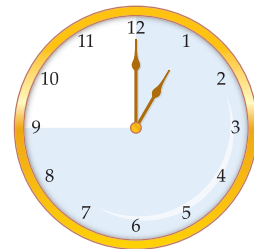
30. $18 \times 11 =$ _____

31. $17 \times 9 =$ _____

32. Hayley's guitar lesson lasts $\frac{3}{4}$ hour. How many minutes does Hayley spend at her guitar lesson? Use the clock to help you find your answer.

MCC5.NF.6 _____

_____

33. Miguel has one foot of string. He cuts the string into fourths. How many inches is each piece of string? MCC5.MD.1 _____

_____

Multiply Fractions

What You'll Learn

Scan the lesson. List two real-world scenarios in which you multiply fractions.

• _____
_____

• _____
_____

Essential Question

WHAT does it mean to multiply and divide fractions?

Common Core GPS

Content Standards
MCC5.NF.6, Preparation for MCC6.NS.1

Mathematical Practices
1, 3, 4, 5, 7

Real-World Link

Watch ▶

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.

$\vdash$ ———— $\frac{2}{3}$ ft ———— $\dashv$

$\frac{1}{2}$ size of tongue
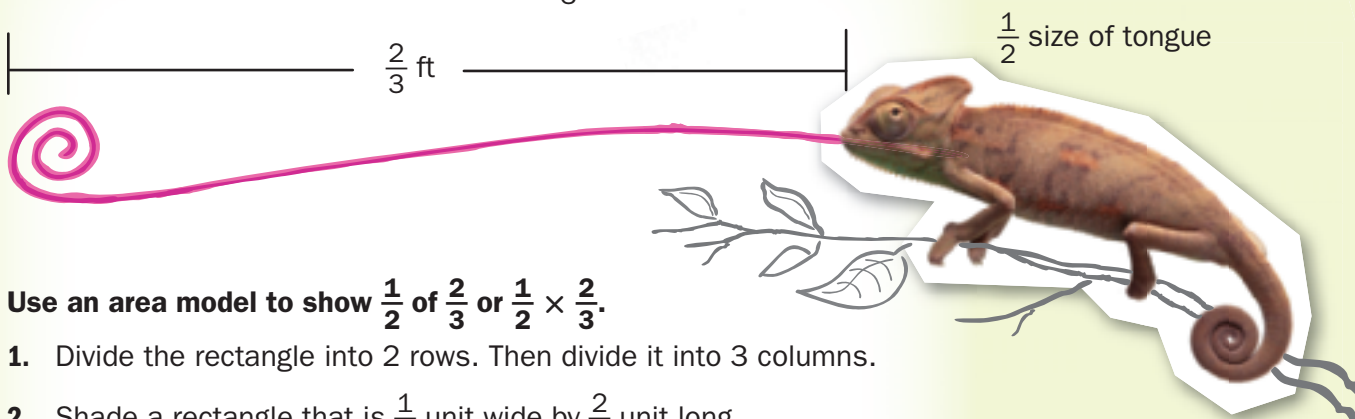
Use an area model to show $\frac{1}{2}$ of $\frac{2}{3}$ or $\frac{1}{2} \times \frac{2}{3}$.

1. Divide the rectangle into 2 rows. Then divide it into 3 columns.

2. Shade a rectangle that is $\frac{1}{2}$ unit wide by $\frac{2}{3}$ unit long.
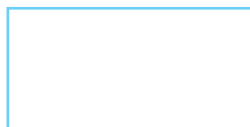
3. Refer to the model. The section that was shaded represents $\frac{1}{2} \times \frac{2}{3}$. What fraction represents $\frac{1}{2} \times \frac{2}{3}$? _____

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

_____
_____
_____

Key Concept — Multiply Fractions

Words   Multiply the numerators and multiply the denominators.

Models

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

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

Numbers $\frac{2}{5} \times \frac{1}{2} = \frac{2 \times 1}{5 \times 2}$

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

Example

1. Find $\frac{1}{3} \times \frac{1}{4}$. Write in simplest form.
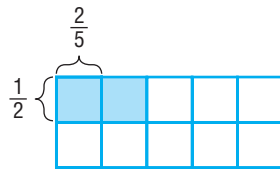
Method 1   Use a model.

Divide the rectangle into 4 rows. Then divide the rectangle into 3 columns.

Shade a section that is $\frac{1}{4}$ unit wide by $\frac{1}{3}$ unit long.

The section that is shaded represents $\frac{1}{4} \times \frac{1}{3}$, or $\frac{1}{12}$.

$$\frac{1}{3}$$

$$\frac{1}{4}$$
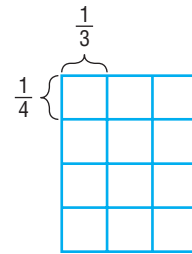
Method 2   Use an equation.

$\frac{1}{3} \times \frac{1}{4} = \blacksquare$

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

$\phantom{\frac{1}{3} \times \frac{1}{4}} = \frac{1}{12}$ Simplify.

So, $\frac{1}{3} \times \frac{1}{4}$ is $\frac{1}{12}$.

Show your work.

Got It?   Do these problems to find out.

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

a. _____

b. _____

c. _____

Simplify Before Multiplying

If the numerators and the denominators have a common factor you can simplify *before* you multiply. Remember that factors are two or more numbers that are multiplied together to form a product.

$$\frac{2}{3} \times \frac{\cancel{5}^{1}}{6} = 2 \times \frac{5}{\cancel{3}_{3}} \times 6$$

Think: $2 \div 2 = 1$
Think: $6 \div 2 = 3$

$$= \frac{5}{9}$$

Examples

Tutor

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

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

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

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

Check for reasonableness $\frac{1}{2} \approx \frac{5}{8}$ ✔

. . . .

3. Find $\frac{4}{9} \times 18$.

Estimate $\frac{1}{2} \times 18 = 9$

$$\frac{4}{9} \times 18 = \frac{4}{9} \times \frac{18}{1}$$ Write 18 as a fraction with a denominator of 1.

$$= \frac{4 \times \cancel{18}^{2}}{\cancel{9}_{1} \times 1}$$ Divide both the numerator and the denominator by 9.

$$= \frac{8}{1} \text{ or } 8$$ Simplify. Compare to the estimate.

Check for reasonableness $9 \approx 8$ ✔

Got It? Do these problems to find out.

d. $\frac{3}{4} \times \frac{4}{9}$

e. $\frac{5}{6} \times \frac{9}{10}$

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

Simplifying
When multiplying fractions, it is easier to find the answer if you simplify before multiplying.

Show your work.

d. _____

e. _____

f. _____

Example

4. Frank had $\frac{1}{2}$ of the lawn left to mow. On Saturday, he mowed $\frac{2}{3}$ of what was left. What fraction of the entire lawn did Frank mow on Saturday?

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

$$= \frac{1}{3}$$ Simplify.

So, Frank mowed $\frac{1}{3}$ of the lawn on Saturday.

Guided Practice

Check ✓

Multiply. Write in simplest form. (Examples 1–3)

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

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

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

Show your work.

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

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

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

7. Rick has $\frac{1}{2}$ of a footlong sub left from yesterday. He ate $\frac{1}{3}$ of the leftover sandwich as a snack. What fraction of the entire sandwich did he eat as a snack? (Example 4)

_____

_____

8. 🅠 **Building on the Essential Question** If two positive fractions are less than 1, why is their product also less than 1?

_____

_____

_____

Rate Yourself!

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

I have a few questions.

I'm ready to move on.

I have a lot of questions.

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

Tutor

FOLDABLES *Time to update your Foldable!*

Independent Practice

eHelp

Multiply. Write in simplest form. (Examples 1–3)

1. $\frac{1}{3} \times \frac{2}{5} =$ _____

Show your work.

2. $\frac{3}{4} \times \frac{5}{8} =$ _____

3. $\frac{2}{3} \times 4 =$ _____

4. $\frac{5}{6} \times 15 =$ _____

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

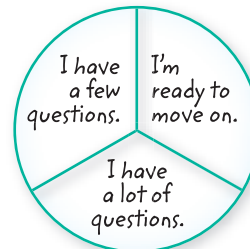6. $\frac{4}{9} \times \frac{3}{8} =$ _____

7. **Financial Literacy** Juanita spent $\frac{3}{4}$ of her allowance at the mall. Of the money spent at the mall, $\frac{1}{2}$ was spent on new earphones. What part of her allowance did Juanita spend on earphones? (Example 4)

_____

_____

8. A paint store has 35 gallons of paint in storage, $\frac{2}{5}$ of which are for outdoor use. The others are for indoor use. If each gallon costs $22, what is the total cost of the indoor paint in storage?

_____

_____

9. Homeroom 101 and Homeroom 102 share a hallway bulletin board. If Homeroom 101 uses $\frac{3}{5}$ of their half to display artwork, what fraction of the bulletin board is used to display Homeroom 101's artwork?

_____

_____

10. **Use Math Tools** Mr. Williams' physical education class lasts for $\frac{7}{8}$ hour.
   a. How many minutes are spent warming up and cooling down?

   _____

   _____

   b. How many minutes are *not* spent on instruction? Explain.

   _____

   _____

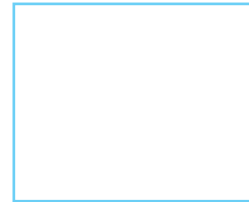| Part of $\frac{7}{8}$-hour Class	
playing game	$\frac{1}{2}$
instruction	$\frac{1}{5}$
warm-up and cool-down	$\frac{3}{10}$

11. CCSS **Multiple Representations** Use the bar diagram.

a. **Words** Write a real-world problem represented by the bar diagram. _____

_____
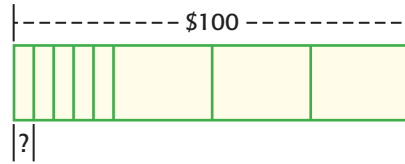
b. **Models** Draw an area model to represent the situation.

c. **Words** Explain how you would solve your problem.

_____

_____

|----------- $100 -----------|

|?|

---

12. CCSS **Reason Inductively** State whether each statement is *true* or *false*. If the statement is *false*, provide a counterexample.

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

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

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

13. CCSS **Identify Structure** If the product of two positive fractions a and b is $\frac{15}{56}$, find three pairs of possible values for a and b. _____

_____

14. CCSS **Persevere with Problems** Justify why $\frac{a}{b} \times \frac{b}{c} \times \frac{c}{d} \times \frac{d}{e}$ is equal to $\frac{a}{e}$ when $b, c, d,$ and e are not zero. _____

_____

Georgia Test Practice

15. 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?

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

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

Extra Practice

Multiply. Write in simplest form.

16. $\frac{1}{8} \times \frac{3}{4} = \frac{3}{32}$ _____

$$\frac{1 \times 3}{8 \times 4} = \frac{3}{32}$$

Homework Help ➡

17. $\frac{2}{5} \times \frac{3}{7} = \frac{6}{35}$ _____

$$\frac{2 \times 3}{5 \times 7} = \frac{6}{35}$$

18. $\frac{3}{4} \times 2 =$ _____

19. $\frac{3}{8} \times 11 =$ _____

20. $\frac{3}{5} \times \frac{5}{7} =$ _____

21. $\frac{2}{5} \times \frac{5}{6} =$ _____

22. The bleachers at a football game are $\frac{7}{8}$ full, and $\frac{1}{2}$ of the fans in the bleachers are rooting for the home team. What fraction of the bleachers are filled with home-team fans? Justify your procedure.

_____

_____

23. The table shows the fraction of the votes that each candidate received. If 230 students voted, how many students voted for

each candidate? _____

_____

_____

Candidate	Fraction of Votes
Nyemi	$\frac{3}{5}$
Luke	$\frac{3}{10}$
Natalie	$\frac{1}{10}$

24. 🍪 **Model with Mathematics** Alberto rode $\frac{5}{8}$ of the water rides at a water park. His sister, Reina, rode half of the rides that Alberto rode. What fraction of the water rides did Reina *not* ride? Support your answer with a model. _____

_____
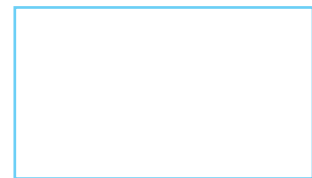
25. 🍪 **Justify Conclusions** Lee is making chocolate chip cookies and the recipe calls for $\frac{3}{4}$ cup of chocolate chips. If she wants to make $\frac{2}{3}$ of the recipe, what fraction of a cup of chocolate chips will she need? Explain.

_____

_____

26. Scott is taking a $\frac{3}{4}$-hour dance class twice a week for 8 weeks. How many hours will Scott have spent in dance class at the end of the 8 weeks?
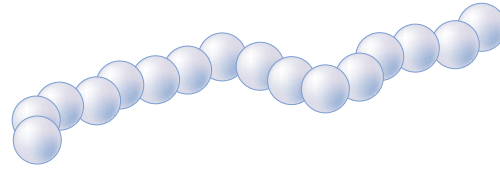
  Ⓐ 6 hours

  Ⓑ 8 hours

  Ⓒ 12 hours

  Ⓓ 16 hours

27. Amanda is stringing beads to make an anklet. The beads are $\frac{1}{4}$-inch wide. The anklet has a string of 16 beads so far. How long is the string of beads?

  Ⓕ 8 inches   Ⓗ 4 inches

  Ⓖ $6\frac{1}{2}$ inches   Ⓘ $3\frac{3}{4}$ inches

28. Short Response Four fifths of Terrence's text messages are to his friends. One half of those messages are to his friend Bianca. What fraction of Terrence's text messages are to Bianca?

_____

_____

Common Core Review

Multiply. MCC5.NBT.5

29. $12 \times 6 \times 9 =$ _____

30. $5 \times 22 \times 3 =$ _____

31. $15 \times 8 \times 11 =$ _____

32. Elise planted a row of flowers in an area with the dimensions shown at the right. What is the area of her flower garden? MCC5.NF.4b

$\frac{1}{2}$ ft

8 ft

_____

_____
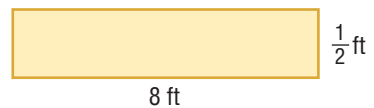
33. Without multiplying, determine whether the product of $5 \times \frac{4}{5}$ is located on the number line at point *A*, *B*, or *C*. Explain your reasoning. MCC5.NF.5b

     A   *B*   *C*

     0   5   10

_____

_____

_____
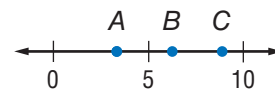
Multiply Mixed Numbers

What You'll Learn

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

- _____

_____

- _____

_____

Essential Question

WHAT does it mean to multiply and divide fractions?

Common Core GPS

Content Standards
MCC5.NF.6, Preparation for MCC6.NS.1

Mathematical Practices
1, 3, 4, 5

Real-World Link

Watch ▶

Animals The eyeball of an Atlantic Giant Squid is about 12 times as large as the average human eyeball. The average human eyeball is $1\frac{1}{4}$ inches across. Use a bar diagram to compare the average size of a human eyeball to the average size of a Atlantic Giant Squid's eyeball.

```
├─────────── squid eyeball ───────────┤
┌─────────────────────────────────────┐
│ 1 1/4 │                             │
└─────────────────────────────────────┘
├───┤
human
eyeball
```
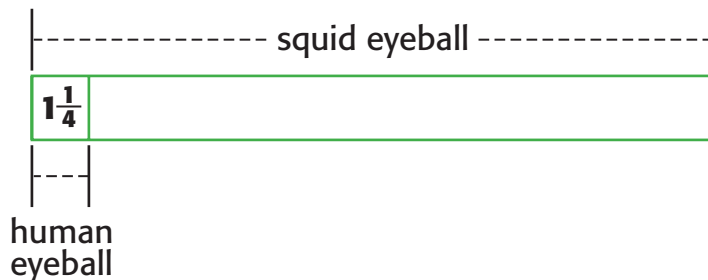
1. Use the diagram above to compare the average size of the Atlantic Giant Squid's eyeball to the average size of the human eyeball. Use repeated addition.

2. Write a multiplication expression that shows the size of the Atlantic Squid's eyeball. _____

3. Write the multiplication expression from Exercise 2 using improper fractions. Multiply to find the size of the squid's eyeball.

_____
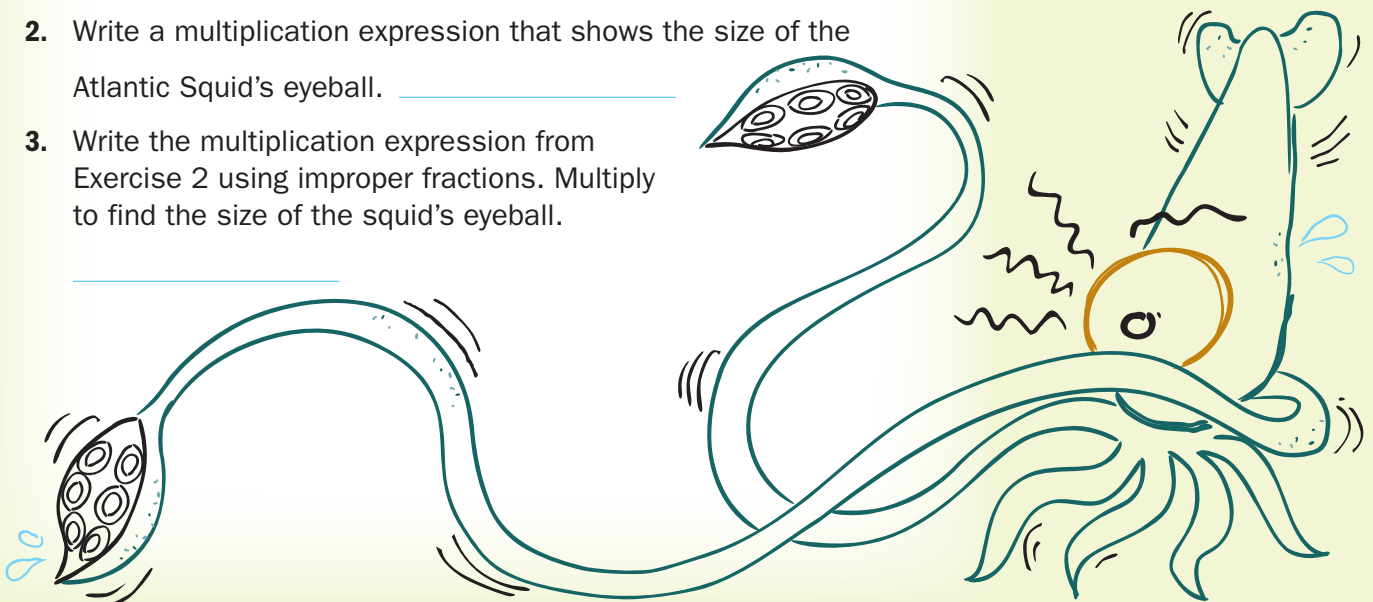
Multiply a Fraction and a Mixed Number

To multiply a fraction and a mixed number, first write the mixed number as an improper fraction. Remember that when mixed numbers are written as improper fractions, the denominator does not change. Then multiply as with fractions.

$$2\frac{1}{2} \times \frac{1}{4} = \frac{5}{2} \times \frac{1}{4}$$
$$= \frac{5 \times 1}{2 \times 4}$$
$$= \frac{5}{8}$$

Examples

Tutor

1. **Find $\frac{1}{3} \times 1\frac{3}{4}$. Write in simplest form.**

Estimate Use compatible numbers. $\frac{1}{2} \times 2 = 1$

$$\frac{1}{3} \times 1\frac{3}{4} = \frac{1}{3} \times \frac{7}{4} \qquad \text{Write } 1\frac{3}{4} \text{ as } \frac{7}{4}.$$
$$= \frac{1 \times 7}{3 \times 4} \qquad \text{Multiply.}$$
$$= \frac{7}{12} \qquad \text{Simplify. Compare to the estimate.}$$

2. **Find $5\frac{1}{2} \times \frac{1}{3}$. Write in simplest form.**

Estimate $\boxed{} \times \dfrac{\boxed{}}{\boxed{}} = \boxed{}$

$$5\frac{1}{2} \times \frac{1}{3} = \frac{\boxed{}}{\boxed{}} \times \frac{1}{3} \qquad \text{Write } 5\frac{1}{2} \text{ as an improper fraction.}$$
$$= \frac{\boxed{} \times}{\boxed{} \times} \qquad \text{Multiply.}$$
$$= \frac{\boxed{}}{\boxed{}} \text{ or } 1\frac{\boxed{}}{\boxed{}} \qquad \text{Simplify.}$$

Check for Reasonableness $1\frac{5}{6} \approx 2$ ✔

Show your work.

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

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

b. $\frac{3}{8} \times 3\frac{1}{3}$

a. _____

b. _____

Multiply Mixed Numbers

To multiply two mixed numbers, write each mixed number as an improper fraction. Use the greatest common factor, or GCF, to simplify.

Examples

3. **Find $1\frac{7}{8} \times 3\frac{1}{3}$. Write in simplest form.**

$$1\frac{7}{8} \times 3\frac{1}{3} = \frac{15}{8} \times \frac{10}{3}$$
Write $1\frac{7}{8}$ as $\frac{15}{8}$. Write $3\frac{1}{3}$ as $\frac{10}{3}$.

$$= \frac{\overset{5}{\cancel{15}}}{\underset{4}{\cancel{8}}} \times \frac{\overset{5}{\cancel{10}}}{\underset{1}{\cancel{3}}}$$
Divide 15 and 3 by their GCF, 3.
Then divide 10 and 8 by their GCF, 2.

$$= \frac{25}{4}$$
Multiply the numerators and multiply the denominators.

$$= 6\frac{1}{4}$$
Simplify.

4. **The 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 $4 \times 3 = 12$

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

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

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

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

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

Check for Reasonableness $12 = 12$ ✔

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

c. 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?

STOP and Reflect

Is the product of two mixed numbers greater than or less than both the factors? Explain below.

Show your work.

c. _____

Example

Tutor

5. Mr. Conrad's pecan pie recipe calls for $1\frac{3}{4}$ cups of pecans. He plans to make 8 pies for his family reunion. How many cups of pecans will Mr. Conrad need?

Estimate $2 \times 8 = 16$

$$1\frac{3}{4} \times 8 = \frac{7}{4} \times \frac{8}{1}$$ Write the mixed number as an improper fraction. Write the whole number as a fraction with a denominator of 1.

$$= \frac{7}{\overset{1}{4}} \times \frac{\overset{2}{8}}{1}$$ Divide 8 and 4 by their GCF, 4.

$$= \frac{7}{1} \times \frac{2}{1}$$ Multiply the numerators and multiply the denominators.

$$= \frac{14}{1} \text{ or } 14$$ Simplify.

Check for Reasonableness $14 \approx 16$ ✔

Mr. Conrad will need 14 cups of pecans.

Guided Practice

Check ✓

Multiply. Write in simplest form. (Examples 1–3)

1. $\frac{1}{2} \times 2\frac{3}{8} =$ _____

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

3. $1\frac{2}{3} \times 2\frac{4}{7} =$ _____

Show your work.

4. Melanie is training for a track meet. She ran $2\frac{1}{4}$ miles 5 times this week. How far did Melanie run this week?

(Examples 4 and 5) _____

5. ⓔ **Building on the Essential Question** How do you multiply mixed numbers? _____

_____

_____

Rate Yourself!

☐ I understand how to multiply mixed numbers.

▶▶ Great! You're ready to move on!

☐ I still have some questions about multiplying mixed numbers.

▦ No Problem! Go online to access a Personal Tutor. **Tutor**

FOLDABLES Time to update your Foldable!

Independent Practice

eHelp

Multiply. Write in simplest form. (Examples 1–3)

1. $\frac{1}{2} \times 2\frac{1}{3} =$ _____

2. $1\frac{7}{8} \times \frac{4}{5} =$ _____

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

Show your work.

4. $1\frac{2}{3} \times 1\frac{1}{4} =$ _____

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

6. $6\frac{2}{3} \times 3\frac{3}{10} =$ _____

7. A carp can travel at a speed of $3\frac{7}{10}$ miles per hour. At this rate, how far can a carp travel in $2\frac{1}{2}$ hours? (Example 4)

_____

_____

8. Juliette is making fruit salad. She purchased $9\frac{2}{3}$ ounces each of 6 different fruits. How many ounces of fruit did she purchase? (Example 5)

_____

_____

9. 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 4)

_____

_____

10. **Model with Mathematics** 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.

_____

_____

11. **STEM** Earth is about $92\frac{9}{10}$ million miles from the Sun. Use the table shown.

    a. How far is Venus from the Sun? _____

    b. How far is Mars from the Sun? _____

    c. How far is Jupiter from the Sun? _____

    d. 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	$9\frac{1}{2}$

Multiply. Write in simplest form.

12. $\dfrac{3}{4} \times 2\dfrac{1}{2} \times \dfrac{4}{5} =$ _____

13. $\dfrac{1}{7} \times 5\dfrac{5}{6} \times 1\dfrac{1}{4} =$ _____

H.O.T. Problems   Higher Order Thinking

14. **CCGPS** **Persevere with Problems** Analyze each product in the table.

a. Why is the first product less than $\dfrac{3}{4}$?

_____

_____

_____

b. Why is the second product equal to $\dfrac{3}{4}$?

_____

_____

_____

c. Why is the third product greater than $\dfrac{3}{4}$?

_____

_____

_____

First Factor		Second Factor		Product
$\dfrac{1}{2}$	×	$\dfrac{3}{4}$	=	$\dfrac{3}{8}$
1	×	$\dfrac{3}{4}$	=	$\dfrac{3}{4}$
$\dfrac{3}{2}$	×	$\dfrac{3}{4}$	=	$\dfrac{9}{8}$

15. **CCGPS** **Use Math Tools** Without multiplying, determine whether the product of $2\dfrac{1}{2} \times \dfrac{2}{3}$ is located on the number line at point A, B, or C. Explain your reasoning. _____

_____
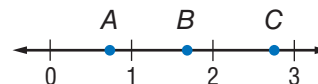
Georgia Test Practice

16. Which number when multiplied by $\dfrac{3}{4}$ gives a product between $\dfrac{3}{4}$ and 1?

Ⓐ 0

Ⓒ $\dfrac{3}{4}$

Ⓑ $\dfrac{1}{4}$

Ⓓ $1\dfrac{1}{4}$

Extra Practice

Multiply. Write in simplest form.

17. $\frac{3}{4} \times 2\frac{5}{6} =$ _$2\frac{1}{8}$_

Homework Help →

$\frac{3}{4} \times 2\frac{5}{6} = \frac{\cancel{3}}{4} \times \frac{17}{\cancel{6}_2}$

$= \frac{1 \times 17}{4 \times 2}$

$= \frac{17}{8} \text{ or } 2\frac{1}{8}$

18. $1\frac{4}{5} \times \frac{5}{6} =$ _$1\frac{1}{2}$_

$1\frac{4}{5} \times \frac{5}{6} = \frac{\cancel{9}^3}{\cancel{5}_1} \times \frac{\cancel{5}^1}{\cancel{6}_2}$

$= \frac{3 \times 1}{1 \times 2}$

$= \frac{3}{2} \text{ or } 1\frac{1}{2}$

19. $\frac{3}{10} \times 2\frac{5}{6} =$ _____

20. $3\frac{1}{5} \times 3\frac{1}{6} =$ _____

21. $4\frac{1}{2} \times 2\frac{5}{6} =$ _____

22. $3\frac{3}{5} \times 5\frac{5}{12} =$ _____

23. CCGPS **Model with Mathematics** 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.

_____

_____

24. A photograph is $5\frac{1}{3}$ inches wide. It is being enlarged to 3 times its original size. What is the width of the enlarged photograph?

_____

_____

25. Jalisa is making bracelets with leather bands. Each bracelet uses $7\frac{3}{4}$ inches of leather banding. She plans to make 4 bracelets. How many inches of leather banding will she need?

_____

_____

26. CCGPS **Use Math Tools** Find examples of mixed numbers in a newspaper or magazine, on television, or on the Internet. Write a real-world problem in which you would multiply mixed numbers.

_____

_____

27. Davis runs at a speed of $4\frac{3}{4}$ miles per hour. At this rate, how far can he run in $3\frac{1}{2}$ hours?

  Ⓐ $4\frac{1}{3}$ Ⓒ $12\frac{3}{8}$

  Ⓑ $4\frac{1}{2}$ Ⓓ $16\frac{5}{8}$

28. Short Response Ben is taking guitar classes three times a week for 8 weeks. Each class will last $1\frac{3}{4}$ hours. How many hours will Ben have spent in guitar classes in 8 weeks?

_____

29. Ally's picture frame is shown. What is the area of Ally's picture frame?

  Ⓕ $8\frac{1}{4}$ in²   Ⓗ $67\frac{1}{16}$ in²

  Ⓖ $63\frac{1}{16}$ in²   Ⓘ $268\frac{1}{4}$ in²

$7\frac{1}{4}$ in.

$9\frac{1}{4}$ in.
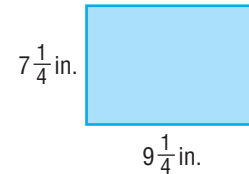
CCGPS Common Core Review

Find each equivalent measurement. MCC5.MD.1

30. 1 foot = _____ inches

31. 1 gallon = _____ quarts

32. 1 yard = _____ feet

33. 1 cup = _____ fluid ounces

34. 24 inches = _____ feet

35. 9 feet = _____ yards

36. Leah's younger sister measures $\frac{41}{12}$ feet tall. Rewrite this as a mixed number. MCC5.NF.3

_____

37. Graph the points (1, 3), (2, 6), and (3, 9) on the coordinate plane. MCC5.G.2
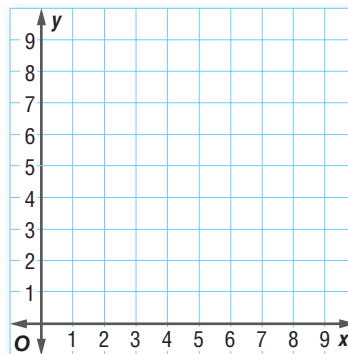
Convert Measurement Units

What You'll Learn

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

- _____
  _____
- _____
  _____

Essential Question

WHAT does it mean to multiply and divide fractions?

Vocab

Vocabulary

unit ratio
dimensional analysis

Common Core GPS

Content Standards
MCC6.RP.3, MCC6.RP.3d

Mathematical Practices
1, 3, 4, 6

Real-World Link

Watch ▶

Animals The table shows the approximate weights in tons of several large land animals. One ton is equivalent to 2,000 pounds. You can use a ratio table to convert each weight from tons to pounds.

Animal	Weight (T)
Grizzly bear	1
White rhinoceros	4
Hippopotamus	5
African elephant	8

1. Complete the ratio table. The first two ratios are done for you. To produce equivalent ratios, multiply the quantities in each row by the same number.

Tons	1	4	5	8
Pounds	2,000	8,000		

2. Use the coordinate plane shown.
   a. Graph the ordered pairs (tons, pounds) from the table on the coordinate plane.
   b. Label the horizontal axis *Weight in Tons.*
   c. Label the vertical axis *Weight in Pounds.*
   d. Connect the points and describe the graph.

   _____
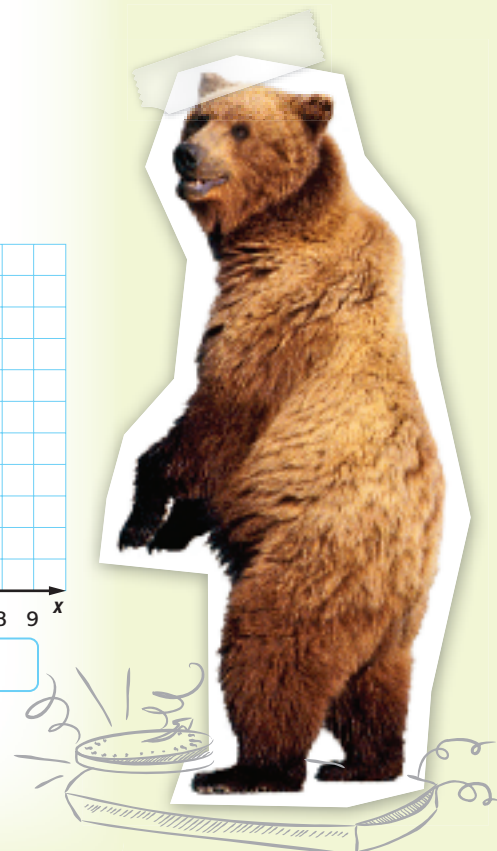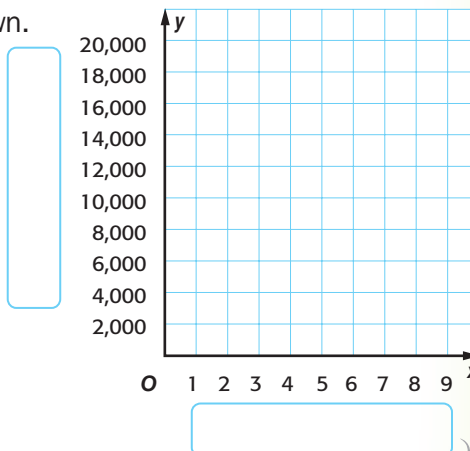
Convert Larger Units to Smaller Units

Each relationship in the table can be written as a ratio. For example, you know that 1 yard = 3 feet. You can use the ratio $\frac{3 \text{ ft}}{1 \text{ yd}}$ to convert from yards to feet.

Customary Conversions			
Type of Measure	**Larger Unit**	→	**Smaller Unit**
Length	1 foot (ft) 1 yard (yd) 1 mile (mi)	= = =	12 inches (in.) 3 feet 5,280 feet
Weight	1 pound (lb) 1 ton (T)	= =	16 ounces (oz) 2,000 pounds
Capacity	1 cup (c) 1 pint (pt) 1 quart (qt) 1 gallon (gal)	= = = =	8 fluid ounces (fl oz) 2 cups 2 pints 4 quarts

Like a unit rate, a **unit ratio** is one in which the denominator is 1 unit. So, the ratio $\frac{3 \text{ ft}}{1 \text{ yd}}$ is a unit ratio.

Dimensional analysis is the process of including units of measurement as factors when you compute.

Multiplying by 1

The ratio $\frac{3 \text{ ft}}{1 \text{ yd}}$ is equivalent to 1 because the numerator and the denominator represent the same amount.

Show your work.

Example

Tutor

1. **Convert 20 feet to inches.**

Since 1 foot = 12 inches, the unit ratio is $\frac{12 \text{ in.}}{1 \text{ ft}}$.

$20 \text{ ft} = 20 \text{ ft} \times \dfrac{12 \text{ in.}}{1 \text{ ft}}$ Multiply by $\frac{12 \text{ in.}}{1 \text{ ft}}$.

$= 20 \, \cancel{\text{ft}} \times \dfrac{12 \text{ in.}}{1 \, \cancel{\text{ft}}}$ Divide out common units, leaving the desired unit, inches.

$= 20 \times 12 \text{ in.}$ Multiply.

$= 240 \text{ in.}$

So, 20 feet = 240 inches.

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

Complete.

a. _____

b. _____

c. _____

a. $36 \text{ yd} = \blacksquare \text{ ft}$ **b.** $\frac{3}{4} \text{ T} = \blacksquare \text{ lb}$ **c.** $1\frac{1}{2} \text{ qt} = \blacksquare \text{ pt}$

Example

2. Marco mixes $\frac{1}{4}$ cup of fertilizer with soil before planting each bulb. How many fluid ounces of fertilizer does he use per bulb?

$\frac{1}{4}$ c $= \frac{1}{4}$ c̸ $\times \frac{8 \text{ fl oz}}{1 \text{ c̸}}$ Since 1 cup = 8 fluid ounces, multiply by $\frac{8 \text{ fl oz}}{1 \text{ c}}$. Then, divide out common units.

$= \frac{1}{4} \times 8$ fl oz   Multiply.

$= 2$ fl oz

So, 2 fluid ounces of fertilizer are used per bulb.

Got It? Do this problem to find out.

d. Jen runs $\frac{1}{8}$ of a mile before tennis practice. How many feet does she run before practice?

Show your work.

d. _____

Convert Smaller Units to Larger Units

Remember that the ratios $\frac{1 \text{ yd}}{3 \text{ ft}}$ and $\frac{3 \text{ ft}}{1 \text{ yd}}$ are equivalent. To convert from smaller units to larger units, choose the ratio that allows you to divide out the common units.

Example: 12 ft $\times \dfrac{1 \text{ yd}}{3 \text{ ft}}$ ✔   ~~12 ft $\times \dfrac{3 \text{ ft}}{1 \text{ yd}}$~~

Example

Tutor

3. Convert 15 quarts to gallons.

Since 1 gallon = 4 quarts, and quarts are smaller units than gallons, use the ratio $\frac{1 \text{ gal}}{4 \text{ qt}}$.

15 qt $= 15$ qt $\times \dfrac{1 \text{ gal}}{4 \text{ qt}}$ Multiply by $\frac{1 \text{ gal}}{4 \text{ qt}}$.

$= 15$ q̸t̸ $\times \dfrac{1 \text{ gal}}{4 \text{ q̸t̸}}$ Divide out common units, leaving the desired unit, gallons.

$= 15 \times \dfrac{1}{4}$ gal   Multiplying 15 by $\frac{1}{4}$ is the same as dividing 15 by 4.

$= 3.75$ gal

e. _____

f. _____

Got It? Do these problems to find out.

e. 2,640 ft = ▪ mi   **f.** 100 oz = ▪ lb   **g.** 3 c = ▪ pt

g. _____

Example

4. Umeka needs $4\frac{1}{2}$ feet of fabric to make a costume for a play. How many yards of fabric does she need?

$$4\frac{1}{2} \text{ ft} = 4\frac{1}{2} \text{ ft} \times \frac{1 \text{ yd}}{3 \text{ ft}}$$

Since 1 yard = 3 feet, multiply by $\frac{1 \text{ yd}}{3 \text{ ft}}$. Then, divide out common units.

$$= \frac{\overset{3}{\cancel{9}}}{2} \times \frac{1}{\underset{1}{\cancel{3}}} \text{ yd}$$

Write $4\frac{1}{2}$ as an improper fraction. Then divide out common factors.

$$= \frac{3}{2} \text{ yd or } 1\frac{1}{2} \text{ yd}$$

Multiply.

So, Umeka needs $1\frac{1}{2}$ yards of fabric.

Guided Practice

Complete. (Examples 1 and 3)

1. $5\frac{1}{3}$ yd = _____ ft

2. $4\frac{1}{2}$ pt = _____ c

3. 12 qt = _____ gal

4. 28 in. = _____ ft

Show your work.

5. A large grouper can weigh $\frac{1}{3}$ ton. How much does a large grouper weigh to the nearest pound? (Example 2) _____

6. The world's narrowest electric vehicle is about 35 inches wide. How wide is this vehicle to the nearest foot? (Example 4) _____

7. (Q) **Building on the Essential Question** How can you use ratios to convert units of measurement?

_____

_____

_____

_____

Rate Yourself!

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

YES ? NO
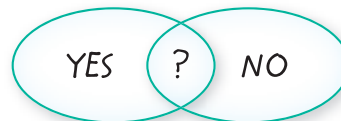
For more help, go online to access a Personal Tutor.

Independent Practice

eHelp

Complete. (Examples 1 and 3)

1. 18 ft = _____ yd

Show your work.

2. 2 lb = _____ oz

3 6.5 c = _____ fl oz

4. 2 mi = _____ ft

5. 5,000 lb = _____ T

6. $2\frac{3}{4}$ qt = _____ pt

7 One of the largest pumpkins ever grown weighed about $\frac{3}{4}$ ton. How many pounds did the pumpkin weigh? (Example 2)

_____

8. A 40-foot power boat is for sale by owner. How long is the boat to the nearest yard? (Example 4)

_____

Show your work.

9. A 3-pound pork loin can be cut into 10 pork chops of equal weight. How many ounces is each pork chop? _____

_____

10. **CCSS** **Model with Mathematics** Will a 2-quart pitcher hold the entire recipe of citrus punch given at the right? Explain your reasoning.

_____

_____

_____

_____

> **Citrus Punch Drink**
> 2 cups orange juice
> 2 cups grapefruit juice
> $\frac{1}{4}$ cup apricot nectar
> $\frac{1}{3}$ cup pineapple juice
> 4 cups ginger ale

11. CCGPS **Multiple Representations** Use the graph at the right.

  a. Numbers What does an ordered pair from this graph represent? _____

  _____

  b. Measurement Use the graph to find the capacity in quarts of a 2.5-gallon container. Explain your reasoning.

  _____

  _____

Capacity (gallons) vs *Capacity (quarts)*

H.O.T. Problems Higher Order Thinking

12. CCGPS **Model with Mathematics** Write a real-world problem in which you would need to convert pints to cups. _____

_____

_____

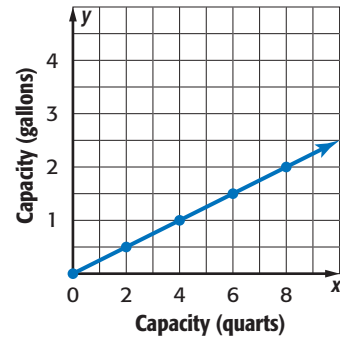CCGPS **Persevere with Problems** Fill in each ◯ with <, >, or = to make a true sentence. Justify your answers.

13. 16 in. ◯ $1\frac{1}{2}$ ft   **14.** $8\frac{3}{4}$ gal ◯ 32 qt

_____   _____

_____   _____

15. CCGPS **Persevere with Problems** Give two different measurements that are equivalent to $2\frac{1}{2}$ quarts. _____

Georgia Test Practice

16. Which of the following situations is represented by the graph?

  Ⓐ conversion of inches to yards

  Ⓑ conversion of feet to inches

  Ⓒ conversion of miles to feet

  Ⓓ conversion of yards to feet
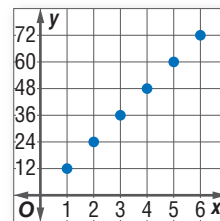
Extra Practice

Complete.

17. 72 oz = $4\frac{1}{2}$ _____ lb

$72 \text{ oz} = 72 \text{ oz} \times \frac{1 \text{ lb}}{16 \text{ oz}}$

Homework Help

$= \frac{\cancel{72}^{9}}{1} \times \frac{1}{\cancel{16}_{2}} \text{ lb}$

$= \frac{9}{2} \text{ or } 4\frac{1}{2}$

18. 4 gal = 16 _____ qt

$4 \text{ gal} = 4 \text{ gal} \times \frac{4 \text{ qt}}{1 \text{ gal}}$

$= \frac{4}{1} \times \frac{4}{1} \text{ qt}$

$= \frac{16}{1} \text{ or } 16 \text{ qt}$

19. 3 c = _____ fl oz

20. $1\frac{1}{4}$ mi = _____ ft

21. 13 c = _____ pt

22. $3\frac{3}{8}$ T = _____ lb

23. Speed skiing takes place on a course that is $\frac{2}{3}$ mile long. How many feet long is the course?

Show your work.

_____

24. A total of 35 pints of blood were collected at a local blood drive. How many quarts of blood were collected?

_____

25. **STEM** On Monday, it snowed a total of 15 inches. On Tuesday and Wednesday, it snowed an additional $4\frac{1}{2}$ inches and $6\frac{3}{4}$ inches, respectively. A weather forecaster says that over the last three days, it snowed over $2\frac{1}{2}$ feet. Is this a valid claim? Justify your answer.

_____

_____

CCGPS **Be Precise** **Complete the following statements.**

26. If 16 c = 1 gal, then $1\frac{1}{4}$ gal = _____ c.

27. If 1,760 yd = 1 mi, then 880 yd = _____ mi.

28. If 36 in. = 1 yd, then $2\frac{1}{3}$ yd = _____ in.

29. Which relationship between the given units of measure is true?

- Ⓐ One foot is $\frac{1}{12}$ of an inch.
- Ⓑ One yard is $\frac{1}{3}$ of a foot.
- Ⓒ One yard is $\frac{1}{3}$ of a mile.
- Ⓓ One inch is $\frac{1}{12}$ of a foot.

30. How many cups of milk are shown?

- Ⓕ $\frac{3}{4}$ c
- Ⓖ $1\frac{1}{4}$ c
- Ⓗ $2\frac{1}{2}$ c
- Ⓘ 10 c

31. Which of the following lists the measurements below in order from least to greatest?

$$88 \text{ inches}, 7\frac{1}{2} \text{ feet}, 2\frac{1}{3} \text{ yards}$$

- Ⓐ 88 inches, $7\frac{1}{2}$ feet, $2\frac{1}{3}$ yards
- Ⓑ $7\frac{1}{2}$ feet, 88 inches, $2\frac{1}{3}$ yards
- Ⓒ $2\frac{1}{3}$ yards, $7\frac{1}{2}$ feet, 88 inches
- Ⓓ $2\frac{1}{3}$ yards, 88 inches, $7\frac{1}{2}$ feet

32. Short Response How many quarts are equal to 15 pints? _____

Common Core Review

Divide. MCC5.NBT.6

33. $156 \div 4 =$ _____

34. $212 \div 8 =$ _____

35. $90 \div 12 =$ _____

36. David baked 78 cookies for a bake sale. He set aside 12 cookies to share with volunteers. The remaining cookies are bagged with 3 cookies in each bag. How many bags does David need? MCC4.OA.3 _____

37. Refer to the diagram of a living room. The doorway will not have a baseboard. How many feet of baseboard are needed to go around the room? MCC4.MD.3 _____
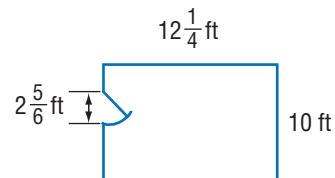
$12\frac{1}{4}$ ft

$2\frac{5}{6}$ ft

10 ft

Case #1 Traction Action

Manuel and his friends celebrated his birthday at the FunTimes game center. He spent $\frac{4}{7}$ of his money at the fun center on go-karts and now he has $15 left.

How much money did he spend on go-karts?

1 Understand *What are the facts?*

You know that Manuel spent $\frac{4}{7}$ of his money on go-karts. You need to determine how much money he spent on go-karts.

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

He spent a fraction of his money. Draw a bar diagram.

3 Solve *How can you apply the strategy?*

Complete the bar diagram using information from the problem. Fill in the missing numbers to show the value of each section.

				5	5	5

|—— Amount Spent on Go-Karts ——|——$15———|

$ ⬚ ÷ ⬚ = $ ⬚
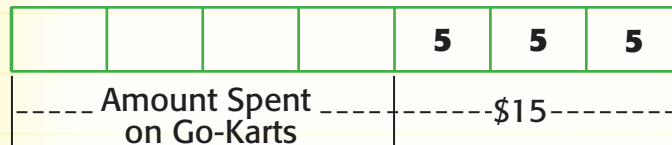
So, each section represents $⬚.

Manuel spent 4 × $⬚ or $⬚ on go-karts.

4 Check *Does the answer make sense?*

Four sevenths of $35 is 4 × ⬚ or $⬚. ✔

Analyze the Strategy [Tutor]

Justify Conclusions Suppose Manuel had $9 left. How much money did he start with? Explain.

_____
_____
_____

Jeremy has $\frac{3}{5}$ as many saved text messages as Ria.

Jeremy has 24 saved text messages.

How many saved text messages do they have in all?

1 Understand

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

I need to find _____.

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

Jeremy has $\dfrac{\boxed{}}{\boxed{}}$ as many saved texts as Ria.

Jeremy has $\boxed{}$ saved texts.

2 Plan

Choose a problem-solving strategy.

I will use the _____ strategy.

3 Solve

Solve the problem using your problem-solving strategy.

- Divide the tape diagram for Jeremy into 3 equal sections and the diagram for Ria into 5 equal sections.
- Jeremy has 24 messages. Fill in the boxes.

Jeremy ▭

Ria ▭

Ria has $\boxed{} \times \boxed{} = \boxed{}$ saved texts.

So, Jeremy and Ria have $\boxed{} + \boxed{}$, or $\boxed{}$ saved texts in all.

4 Check

Use information from the problem to check your answer.

$\frac{3}{5} \times \boxed{} = $ _____

Case #3 Internet

Francesca spent 45 minutes on the Internet yesterday.

If this is $\frac{3}{4}$ of the time she spent on the computer, how long did she spend on the computer, but not on the Internet?

Case #4 Basketball

Mieko practiced shooting a basketball for $\frac{7}{10}$ of her total practice time. During the other time, she practiced dribbling.

If she practiced dribbling for 18 minutes, how many minutes did she practice shooting?

Case #5 Vacation

Of Joseph's vacation pictures, $\frac{4}{9}$ were of his family. The remaining photos were of famous landmarks.

If 45 photos were of landmarks, how many were of his family?
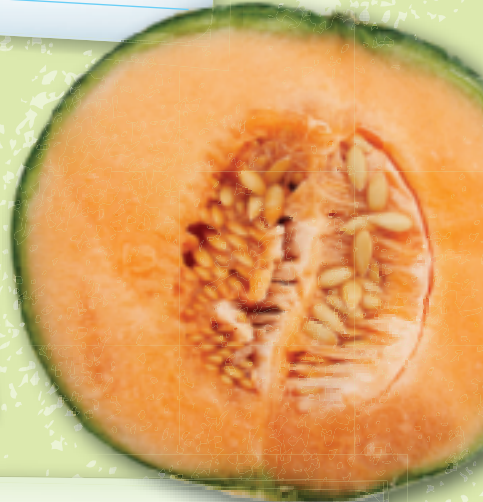
Circle a strategy below to solve the problem.
- Look for a pattern.
- Solve a simpler problem.
- Act it out.
- Make a list.

Case #6 Fruit

Use the table that shows the prices of different amounts of mixed fruit at the grocery store.

How much will 13 pounds of fruit cost?

Pounds	Cost ($)
2	4.50
4	9.00
6	13.50
8	18.00

Mid-Chapter Check

Vocabulary Check

1. **CCSS Be Precise** Define *Commutative Property*. Provide an example of an operation that is commutative. Provide an example of an operation which is not commutative. (Lesson 2)

_____

_____

_____

Skills Check and Problem Solving

Multiply. Write in simplest form. (Lessons 1–4)

2. $8 \times \frac{2}{5} =$ _____

Show your work

3. $\frac{7}{8} \times \frac{2}{3} =$ _____

4. $4\frac{3}{4} \times 2\frac{1}{8} =$ _____

5. A new shirt costs \$14.99. If the shirt is on sale for $\frac{1}{5}$ off its price, about how much would you save? (Lesson 1) _____

6. **CCSS Justify Conclusions** Corey needs 24 boards that are $47\frac{1}{2}$ inches long. (Lesson 5)

a. How many feet of boards should he buy? Explain. _____

_____

b. If you can only buy 8-foot boards, how many should he buy? Explain.

_____

_____

_____

7. **Georgia Test Practice** What is the area of the picture and frame shown? (Lesson 4)

Ⓐ $84\frac{7}{12}$ square inches Ⓒ $82\frac{1}{2}$ square inches

Ⓑ $83\frac{5}{6}$ square inches Ⓓ $77\frac{1}{6}$ square inches
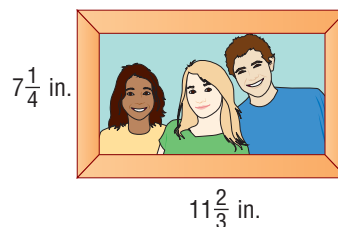
$7\frac{1}{4}$ in.

$11\frac{2}{3}$ in.

Inquiry HOW can a bar diagram help you understand what it means to divide fractions?

Set Design Juan is building a set for the school musical. He has a 3-foot board that he needs to equally divide into $\frac{1}{2}$-foot pieces. How many pieces will he have after he cuts the board?

What do you know? _____

_____

_____

What do you need to find? _____

_____

Investigation 1

Tools

Step 1 Draw a model that represents the length of the board. Draw lines to separate the board into thirds. Each third represents one foot.

Step 2 Divide each foot into halves.

Step 3 Determine how many groups of $\frac{1}{2}$ are in 3. Circle the groups that are the size of the divisor $\frac{1}{2}$.

There are ☐ groups of $\frac{\square}{\square}$. So, $3 \div \frac{1}{2} = \square$.

Check by multiplying: ☐ × $\frac{\square}{\square}$ = ☐ ✔

Investigation 2

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

Step 1   The model represents 4.

$$4$$
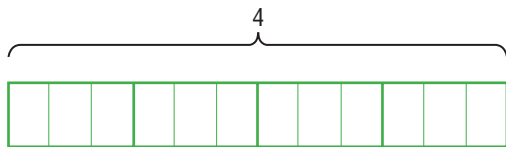
Step 2   Divide each whole into thirds.

Step 3   Circle groups of $\frac{2}{3}$ on the model.   Think: How many groups of $\frac{2}{3}$ are in 4?

There are ☐ groups of $\frac{2}{3}$. So, $4 \div \frac{2}{3} = $ ☐.

Check by multiplying: $☐ \times \dfrac{☐}{☐} = ☐$ ✔

Investigation 3

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

Step 1   The model represents 2.

$$2$$

$\frac{3}{4}$

$\frac{2}{3}$ of a circled group
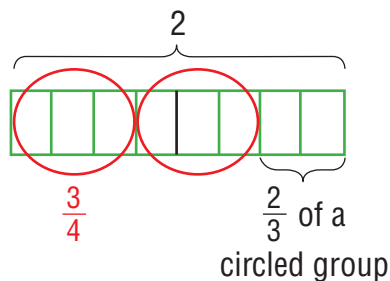
Step 2   Divide each whole into _____.

Step 3   Determine how many groups of $\dfrac{☐}{☐}$ are in ☐.

Circle groups of $\dfrac{☐}{☐}$ on the model.

There are ☐ groups of $\frac{3}{4}$ and $\frac{2}{3}$ of a group left over. So, $2 \div \frac{3}{4} = ☐\dfrac{☐}{☐}$.

Check by multiplying: $☐\dfrac{☐}{☐} \times \dfrac{☐}{☐} = ☐$ ✔

CCSS Model with Mathematics Work with a partner. Draw a diagram to find each quotient.

1. $3 \div \frac{1}{3} = $ _____

Show your work.

2. $2 \div \frac{1}{4} = $ _____

3. $6 \div \frac{2}{3} = $ _____

4. $4 \div \frac{1}{2} = $ _____

5. $3 \div \frac{3}{4} = $ _____

6. $4 \div \frac{3}{4} = $ _____

7. $5 \div \frac{2}{3} = $ _____

8. $2 \div \frac{4}{5} = $ _____

Mikayla is modifying the recipe at the right. Use multiplication to check Mikayla's work. The first one is done for you.

Taco Dip (one serving)
$\frac{1}{2}$ cup sour cream
$\frac{2}{3}$ cup hamburger
$\frac{1}{4}$ cup olives
$\frac{5}{6}$ cup cheese
1 cup tortilla chips
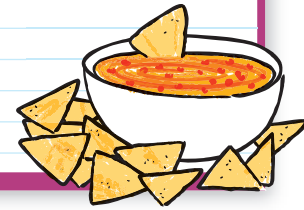
	Cups of Hamburger Used	Number of Servings	Check by Multiplying	Is she correct?
	2	$2 \div \frac{2}{3} = 3$	$3 \times \frac{2}{3} = 2$	Yes
9.	3	$3 \div \frac{2}{3} = 4$		
10.	4	$4 \div \frac{2}{3} = 6$		
11.	5	$5 \div \frac{2}{3} = 7\frac{1}{2}$		
12.	6	$6 \div \frac{2}{3} = 9$		
13.	7	$7 \div \frac{2}{3} = 10\frac{2}{3}$		

14. **CCSS Reason Inductively** Compare the quotients to each of the factors in the table above. In $8 \div \frac{2}{3}$, will the quotient be greater than, less than, or equal to 8? Explain.

_____

_____

Reflect

15. **CCSS Model with Mathematics** Write a story context that involves $4 \div \frac{4}{5}$. Solve the problem and multiply to check your answer.

_____

_____

16. **CCSS Justify Conclusions** Write a real-world problem that involves the division of a whole number by a fraction. Then solve. Justify your procedure.

_____

_____

17. **inquiry** HOW can a bar diagram help you understand what it means to

divide fractions? _____

_____

Divide Whole Numbers by Fractions

What You'll Learn

Scan the lesson. Predict two things you will learn about dividing whole numbers by fractions.

- _____
  _____
- _____
  _____

Vocabulary Start-Up

Any two numbers with a product of 1 are called **reciprocals**.

Complete the table below by finding the reciprocal of $\frac{2}{3}$. Use the _guess, check,_ and _revise_ strategy. The first one is done for you.

Number	Product	Reciprocal
$\frac{1}{2}$	$\frac{1}{2} \times 2 = 1$	2
$\frac{2}{3}$	$\frac{2}{3} \times \dfrac{\square}{\square} = 1$	$\dfrac{\square}{\square}$

Describe the relationship between the numerator and the denominator of a number and its reciprocal. _____

_____

Real-World Link

Another name for reciprocal is _multiplicative inverse._ What are some words in everyday language that are similar to reciprocal or inverse?

_____

Pilots can fly in an _inverted_ position, or upside down. How can you use the everyday meaning of _invert_ to help you remember the mathematical meaning of multiplicative inverse, or reciprocal?

_____
_____

Find Reciprocals

Dividing 3 by $\frac{1}{2}$ gives the same result as multiplying 3 by 2, which is the reciprocal of $\frac{1}{2}$. 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

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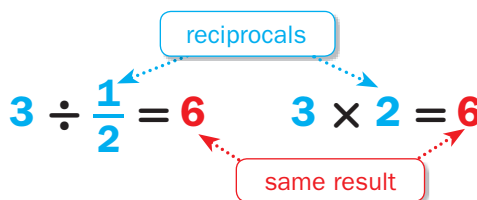
1. **Find the reciprocal of $\frac{2}{3}$.**

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

2. **Find the reciprocal of $\frac{1}{8}$.**

Since $\frac{1}{8} \times \frac{8}{1} = 1$, the reciprocal of $\frac{1}{8}$ is $\frac{8}{1}$ or 8.

3. **Find the reciprocal of 5.**

Write the whole number as a fraction.

$5 = \dfrac{\boxed{}}{1}$

Find the missing factor.

$\dfrac{\boxed{}}{\boxed{}} \times \dfrac{\boxed{}}{\boxed{}} = 1$

The reciprocal of 5 is $\dfrac{\boxed{}}{\boxed{}}$.

Reciprocals

The examples suggest that you "invert" the fraction to find the reciprocal. That is, switch the numerator and denominator. You can use reciprocals to divide fractions.

Show your work.

a. _____

b. _____

c. _____

Got It? Do these problems to find out.

Find the reciprocal of each number.

a. $\frac{3}{5}$ 　　　　　　 b. $\frac{1}{3}$ 　　　　　　 c. 11

Divide by a Fraction

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

Example $5 \div \frac{2}{3} = \frac{5}{1} \times \frac{3}{2}$

The division expression $5 \div \frac{2}{3}$ is read as *5 divided by two thirds.* You need to find how many two thirds are in 5.

Examples

Tutor

4. **Find $2 \div \frac{1}{3}$. Write in simplest form.**

Method 1 **Use a model.**

Model the dividend, 2.

Divide each whole into thirds.

Think: How many thirds are in 2?

Count the total number of sections.
There are 6 sections.

| $\frac{1}{3}$ | $\frac{1}{3}$ | $\frac{1}{3}$ | $\frac{1}{3}$ | $\frac{1}{3}$ | $\frac{1}{3}$ |
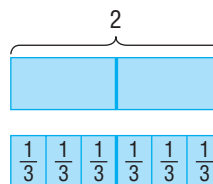
Method 2 **Use an equation.**

$$2 \div \frac{1}{3} = \frac{2}{1} \times \frac{3}{1} \qquad \text{Multiply by the reciprocal of } \frac{1}{3}.$$
$$= \frac{6}{1} \text{ or } 6 \qquad \begin{array}{l}\text{Multiply the numerators.}\\ \text{Multiply the denominators.}\end{array}$$

....

5. **Find $7 \div \frac{2}{3}$. Write in simplest form.**

$$7 \div \frac{2}{3} = \frac{\boxed{}}{\boxed{}} \times \frac{\boxed{}}{\boxed{}} \qquad \begin{array}{l}\text{Write the whole number as a fraction.}\\ \text{Multiply by the reciprocal of } \frac{2}{3}.\end{array}$$

$$\frac{\boxed{}}{\boxed{}} \times \frac{\boxed{}}{\boxed{}} = \frac{\boxed{}}{\boxed{}} \qquad \begin{array}{l}\text{Multiply the numerators.}\\ \text{Multiply the denominators.}\end{array}$$

$$\frac{\boxed{}}{\boxed{}} = \boxed{}\frac{\boxed{}}{\boxed{}} \qquad \text{Simplify.}$$

Show your work.

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

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

d. _____

e. _____

f. _____

Example

6. At summer camp, the duration of a field hockey game is $\frac{3}{4}$ hour. The camp counselors have set aside 6 hours for field hockey games. How many games can be played?

Divide 6 by three fourths.

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

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

$= \frac{8}{1}$ or 8   Simplify.
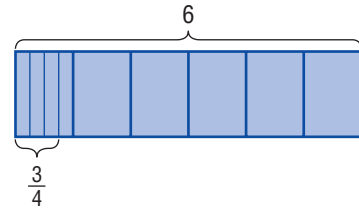
So, 8 games can be played.

Guided Practice

Find the reciprocal of each number. (Examples 1–3)

1. $\frac{2}{3}$ _____

2. $\frac{1}{7}$ _____

3. 4 _____

Show your work.

Divide. Write in simplest form. (Examples 4 and 5)

4. $2 \div \frac{1}{3} =$ _____

5. $2 \div \frac{4}{5} =$ _____

6. $5 \div \frac{2}{7} =$ _____

7. A neighborhood development that is 4 acres is to be divided into $\frac{2}{3}$-acre lots. How many lots can be created? (Example 6) _____

8. **(e)** **Building on the Essential Question** Why does a whole number divided by a fraction less than one have a quotient greater than the whole number dividend?

_____
_____
_____
_____

Rate Yourself!

How well do you understand dividing whole numbers by fractions? Circle the image that applies.

Clear   Somewhat Clear   Not So Clear

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

Tutor

FOLDABLES Time to update your Foldable!

Independent Practice

eHelp

Find the reciprocal of each number. (Examples 1–3)

1. $\frac{3}{5}$ _____

2. $\frac{1}{4}$ _____

3. 1 _____

Show your work.

Divide. Write in simplest form. (Examples 4 and 5)

4. $3 \div \frac{3}{4} =$ _____

5. $5 \div \frac{3}{4} =$ _____

6. $8 \div \frac{4}{7} =$ _____

7. $6 \div \frac{3}{5} =$ _____

8. $2 \div \frac{5}{8} =$ _____

9 $4 \div \frac{8}{9} =$ _____

10. Jamar has an 8-foot-long piece of wood that he wants to cut to build a step stool for his tree house. If each piece is going to be $\frac{5}{6}$ foot long, what is the greatest number of pieces he will be able to use? (Example 6)

_____

_____

11 The average adult horse needs $\frac{2}{5}$ bale of hay each day to meet dietary requirements. A horse farm has 44 bales of hay. How many horses can be fed in one day with 44 bales of hay? (Example 6)

_____

_____

12. CCSS **Justify Conclusions** Ethan ordered 4 sub sandwiches for a party. Each $\frac{1}{2}$ sandwich is one serving. Does he have enough to serve 7 friends? How much is leftover or how much more is needed? Explain. _____

_____

_____

_____
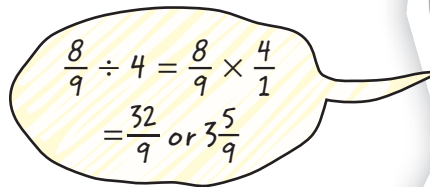
13. Chelsea has four hours of free time on Saturday. She would like to spend no more than $\frac{2}{3}$ of an hour on each activity. How many activities can she do during that time? Justify your procedure.

14. **CCGPS** **Model with Mathematics** Find an example of dividing a whole number by a fraction in a newspaper or on the Internet. Write a real-world problem in which you would divide a whole number by a fraction.

🔥 H.O.T. Problems   Higher Order Thinking

15. **CCGPS** **Find the Error** Daniella is solving $\frac{8}{9} \div 4$. Find her mistake and correct it.

$$\frac{8}{9} \div 4 = \frac{8}{9} \times \frac{4}{1}$$
$$= \frac{32}{9} \text{ or } 3\frac{5}{9}$$

16. **CCGPS** **Persevere with Problems** The Snack Shack is making a batch of trail mix. They use $9\frac{1}{3}$ pounds of granola, $9\frac{1}{3}$ pounds of mixed nuts, and $9\frac{1}{3}$ pounds of yogurt raisins to make the trail mix. They divide the mixture into 14 packages. How much is in each package? Explain.

✏️ Georgia Test Practice

17. How many $\frac{3}{4}$-pound bags of peanuts can be made from the bag of peanuts shown?

- Ⓐ $3\frac{3}{4}$
- Ⓑ $4\frac{1}{4}$
- Ⓒ $5\frac{3}{4}$
- Ⓓ $6\frac{2}{3}$

5 pounds

Extra Practice

Find the reciprocal of each number.

18. $\frac{1}{10}$ _10_

Homework Help ➡ $\frac{1}{10} \times \frac{10}{1} = 1$
The reciprocal is $\frac{10}{1}$ or 10.

19. $\frac{7}{9}$ _____

20. 8 _____

Divide. Write in simplest form.

21. $2 \div \frac{3}{5} = $ _$3\frac{1}{3}$_

$2 \div \frac{3}{5} = \frac{2}{1} \times \frac{5}{3}$
$= \frac{10}{3}$ or $3\frac{1}{3}$

22. $5 \div \frac{5}{6} = $ _____

23. $3 \div \frac{5}{6} = $ _____

24. $10 \div \frac{5}{6} = $ _____

25. $4 \div \frac{5}{9} = $ _____

26. $6 \div \frac{2}{3} = $ _____

27. Turner has 6 pounds of pasta. Each time he makes dinner he uses $\frac{3}{4}$ pound of pasta. How many dinners can he make?

_____

28. **CCGPS** **Use Math Tools** Rafael took 4 pumpkin pies to a family gathering. If he divides each pie into six equal-size slices, how many slices can
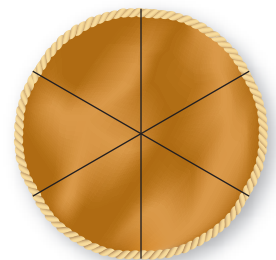
he serve? _____

_____

_____

29. Derreck has $4 to play video games at the mall. Each game costs a quarter to play. Which choice is *not* a correct method for determining the total number of games he can play?

(A) Take the number of dollars he has and multiply it by 0.25.

(B) Take the number of dollars he has and divide it by 0.25.

(C) Take the number of dollars he has and multiply it by 4.

(D) Take the number of dollars he has and divide it by $\frac{1}{4}$.

30. Lenora is following the recipe. How many batches of the recipe can she make if she has 5 cups of vegetable oil?

Salad Dressing
$\frac{1}{3}$ cup vegetable oil
$\frac{1}{4}$ cup vinegar
salt and pepper
to taste
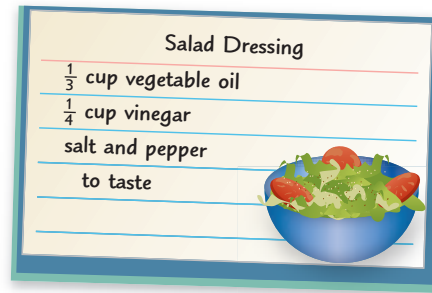
(F) $1\frac{2}{3}$

(G) 3

(H) 15

(I) 20

31. Short Response Jayden has a 10 pound bag of flour. He needs to separate the flour into $\frac{3}{5}$-pound bags. How many bags can he make?

Explain your reasoning. _____

_____

Find an equivalent fraction. MCC5.NF.5b

32. $\frac{2}{3} = \frac{\square}{9}$

33. $\frac{3}{5} = \frac{\square}{20}$

34. $\frac{1}{4} = \frac{\square}{24}$

35. $\frac{5}{6} = \frac{\square}{18}$

36. $\frac{3}{4} = \frac{\square}{32}$

37. $\frac{4}{7} = \frac{\square}{28}$

38. The table shows how far four students walked in 5 minutes. How far did they walk together? MCC5.NF.1 _____

39. Sixty people can receive a piece of pizza if 5 pizzas are purchased. How many people can receive a slice of pizza if 7 pizzas are purchased?

MCC4.OA.3 _____

	Distance (miles)
April	$\frac{3}{4}$
Ping	$\frac{1}{2}$
Hannah	$\frac{2}{3}$
Raj	$\frac{3}{4}$

Inquiry HOW can using models help you divide one fraction by another fraction?

Candy Toby bought $\frac{8}{9}$ pound of mixed candy from the grocery store. He wants to divide the candy into $\frac{2}{9}$-pound bags. How many bags can Toby make?

What do you know? _____

_____

What do you need to find? _____

_____

Investigation 1

To solve the problem use the division sentence $\frac{8}{9} \div \frac{2}{9}$. This shows how many

groups of $\frac{\boxed{}}{\boxed{}}$ are in $\frac{8}{9}$.

Step 1 To make a bar diagram that represents the amount of Toby's candy, divide the bar into $\boxed{}$ sections.

Step 2 Shade $\boxed{}$ of the sections to represent $\frac{8}{9}$ pound.

Step 3 Circle each group of $\frac{2}{9}$ in the shaded section. Determine the number of equal groups of $\frac{2}{9}$.

There are _____ groups of $\frac{2}{9}$ in $\frac{8}{9}$. So, $\frac{8}{9} \div \frac{2}{9} = \boxed{}$.

Toby can make _____ bags of candy that each have $\frac{\boxed{}}{\boxed{}}$ pound.

Investigation 2

Draw a diagram to find $\frac{3}{4} \div \frac{3}{8}$.

Step 1 Rename so the fractions have common denominators. Since 8 is a multiple of 4, rename the fraction $\frac{3}{4}$ as $\frac{\square}{\square}$.

Step 2 Draw a diagram with $\square$ sections and shade $\square$ of the sections to represent $\frac{6}{8}$ pound.

Step 3 Circle each group of $\frac{3}{8}$ in the shaded section. Determine the number of equal groups of $\frac{3}{8}$.

There are _____ groups of $\frac{3}{8}$ in $\frac{6}{8}$.

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

Investigation 3

Draw a diagram to find $\frac{2}{3} \div 2$.

Step 1 Draw a diagram and shade the sections to represent $\frac{\square}{\square}$.

Step 2 Divide the shaded sections into _____ equal groups.

Step 3 Write the fraction that names each group. $\frac{\square}{\square}$

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

Model with Mathematics Work with a partner. Draw a diagram to find each quotient.

1. $\frac{6}{7} \div \frac{2}{7} =$ _____

2. $\frac{4}{5} \div \frac{2}{5} =$ _____

Show your work.

3. $\frac{6}{7} \div \frac{3}{7} =$ _____

4. $\frac{8}{10} \div \frac{2}{5} =$ _____

5. $\frac{3}{4} \div \frac{1}{2} =$ _____

6. $\frac{5}{6} \div \frac{2}{3} =$ _____

7. $\frac{4}{7} \div 2 =$ _____

8. $\frac{12}{13} \div 3 =$ _____

Work with a partner to complete the table. The first one is done for you.

	Division Expression	Quotient	Multiplication Sentence
	$\frac{4}{5} \div \frac{1}{5}$	4	$\frac{1}{5} \times 4 = \frac{4}{5}$
9.	$\frac{8}{9} \div 8$		
10.			$\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$
11.	$\frac{6}{8} \div \frac{2}{8}$		
12.			$\frac{3}{7} \times 1 = \frac{3}{7}$
13.	$\frac{10}{11} \div 5$		
14.			$\frac{5}{9} \times 1 = \frac{5}{9}$

15. **Reason Inductively** Use the table to compare the value of the divisor and the dividend to the value of the quotient. When is the quotient greater than 1?

16. **Make a Conjecture** Some quotients in the table are less than 1. Use the table to write a rule about when the quotient of two fractions will be less than 1.

Reflect

17. **Model with Mathematics** Write a story context that involves $\frac{6}{8} \div \frac{2}{8}$. Solve the problem and multiply to check your answer.

18. **inquiry** HOW can using models help you divide one fraction by another fraction?

Divide Fractions

What You'll Learn

Scan the lesson. List two real-world scenarios in which you would divide fractions.

- _____
  _____

- _____
  _____

Real-World Link

Murals Three students are painting an art mural. The art mural is half painted.

1. Use the picture at the bottom of the page. Divide the painted area into 3 equal parts.

2. Place an X over each part of the painted area. This represents the part each student has painted. Then divide the unpainted area into the same number of parts.

3. What fraction of the whole mural has each

   student painted? $\dfrac{\Box}{\Box}$

4. So, $\dfrac{1}{2} \div 3 = \dfrac{\Box}{\Box}$. It is also true that $\dfrac{1}{2} \times \dfrac{1}{3} = \dfrac{\Box}{\Box}$. Compare

   and contrast the division problem and the multiplication problem.

   _____

   _____

   _____
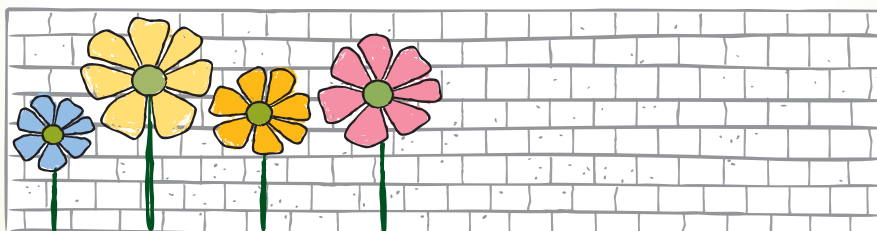
Divide by a Fraction

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

Example

Numbers	**Algebra**
$\dfrac{5}{6} \div \dfrac{2}{3} = \dfrac{5}{6} \times \dfrac{3}{2}$	$\dfrac{a}{b} \div \dfrac{c}{d} = \dfrac{a}{b} \times \dfrac{d}{c}$, where b, c, and $d \neq 0$

Greatest Common Factor (GCF)

The GCF of two or more numbers is the product of all common prime factors.
$4 = 2 \times 2$
$8 = 2 \times 2 \times 2$
The GCF is 2×2 or 4.

Example

Tutor

1. Find $\dfrac{1}{2} \div \dfrac{1}{3}$. **Write in simplest form.**

Method 1 Use a model.

Model the dividend, $\dfrac{1}{2}$.
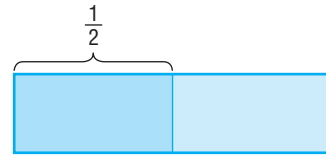
Divide the whole into thirds.
$\dfrac{1}{2} \div \dfrac{1}{3}$ means how many thirds are in $\dfrac{1}{2}$.
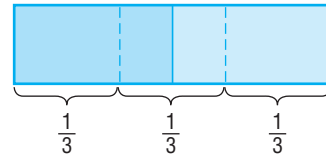
Count the number of $\dfrac{1}{3}$ sections that are in $\dfrac{1}{2}$.
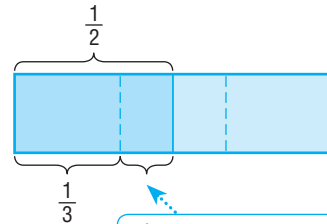
$\dfrac{1}{2}$ of another third

Method 2 Use an equation.

$\dfrac{1}{2} \div \dfrac{1}{3} = \blacksquare$

$\dfrac{1}{2} \div \dfrac{1}{3} = \dfrac{1}{2} \times \dfrac{3}{1}$ Multiply by the reciprocal, $\dfrac{3}{1}$.

$\qquad\quad = \dfrac{3}{2}$ or $1\dfrac{1}{2}$ Multiply the numerators.
Multiply the denominators.

So, $\dfrac{1}{2} \div \dfrac{1}{3} = 1\dfrac{1}{2}$.

Check by multiplying: $\dfrac{3}{2} \times \dfrac{1}{3} = \dfrac{1}{2}$ ✔

Show your work.

a. _____

b. _____

c. _____

Got It? Do these problems to find out.

a. $\dfrac{1}{4} \div \dfrac{3}{8}$ b. $\dfrac{2}{3} \div \dfrac{3}{8}$ c. $\dfrac{5}{6} \div \dfrac{1}{3}$

Example

Tutor

2. **Write a story context for $\frac{2}{3} \div \frac{1}{6}$. Use a model to solve.**

Mariska has $\frac{2}{3}$-pound of sunflower seeds. Each day, she feeds the cardinals in her yard $\frac{1}{6}$ pound of seeds. For how many days will she be able to feed the cardinals?

$$\frac{2}{3}$$
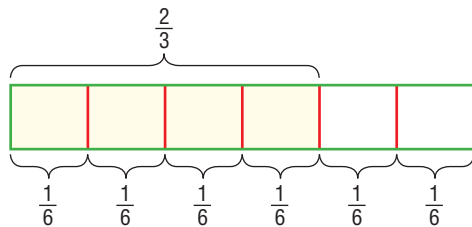
Model $\frac{2}{3}$. The whole is divided into six sections. Count the number of $\frac{1}{6}$ sections.

$$\frac{1}{6} \quad \frac{1}{6} \quad \frac{1}{6} \quad \frac{1}{6} \quad \frac{1}{6} \quad \frac{1}{6}$$

So, Mariska can feed the cardinals for 4 days.

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

d. Write a story context for $\frac{3}{4} \div \frac{1}{8}$. Use a model to solve.

Show your work.

d. _____

Divide a Fraction by a Whole Number

When you divide a fraction by a whole number, rewrite the whole number as a fraction. Then divide as with fractions.

Example

Tutor

3. **Find $\frac{5}{7} \div 10$. Write in simplest form.**

$$\frac{5}{7} \div 10 = \frac{5}{7} \div \frac{10}{1} \quad \text{Write the whole number as a fraction with a denominator of 1.}$$

$$= \frac{5}{7} \times \frac{1}{10} \quad \text{Multiply by the reciprocal.}$$

$$= \frac{\overset{1}{\cancel{5}} \times 1}{7 \times \underset{2}{\cancel{10}}} \quad \text{Divide 5 and 10 by their GCF, 5.}$$

$$= \frac{1}{14} \quad \begin{array}{l}\text{Multiply the numerators.}\\ \text{Multiply the denominators.}\end{array}$$

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

e. $\frac{8}{9} \div 4$ **f.** $\frac{4}{5} \div 8$ **g.** $\frac{12}{13} \div 4$

e. _____

f. _____

g. _____

Example

4. Ramón is making party favors. He is dividing $\frac{3}{4}$ pound of almonds into 12 packages. Write and solve an equation to find how many pounds of almonds are in each package.

To find the number of pounds in each package, solve the equation $\frac{3}{4} \div 12 = \blacksquare$.

$\frac{3}{4} \div 12 = \frac{3}{4} \times \frac{1}{12}$ Multiply by the reciprocal, $\frac{1}{12}$.

$= \frac{\overset{1}{\cancel{3}} \times 1}{4 \times \underset{4}{\cancel{12}}}$ Divide 3 and 12 by their GCF, 3.

$= \frac{1}{16}$ Multiply the numerators. Multiply the denominators.

There will be $\frac{1}{16}$ pound of almonds in each package.

Guided Practice

Check ✓

Divide. Write in simplest form. Check by multiplying. (Examples 1 and 3)

1. $\frac{1}{4} \div \frac{1}{2} =$ _____

2. $\frac{5}{6} \div \frac{2}{3} =$ _____

3. $\frac{1}{8} \div 3 =$ _____

Show your work.

4. Write a story context for $\frac{2}{3} \div \frac{5}{6}$. Use a model to solve. (Example 2)

_____

_____

_____

5. A neighborhood garden that is $\frac{2}{3}$ of an acre is to be divided into 4 equal-size sections. Write and solve an equation to find the size of each section. (Example 4)

_____

6. **Building on the Essential Question** How is the process used to divide fractions similar to the process used to multiply fractions?

_____

_____

_____

Rate Yourself!

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

☹   😐   😊

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

Tutor

FOLDABLES Time to update your Foldable!

Independent Practice

Divide. Write in simplest form. Check by multiplying. (Examples 1 and 3)

1. $\frac{1}{8} \div \frac{1}{2} =$ _____

Show your work.

2. $\frac{3}{4} \div \frac{2}{3} =$ _____

3 $\frac{3}{4} \div 9 =$ _____

4. $\frac{1}{6} \div \frac{4}{7} =$ _____

5. $\frac{1}{3} \div 8 =$ _____

6. $\frac{1}{3} \div \frac{5}{6} =$ _____

7. Write a story context for $\frac{5}{6} \div \frac{1}{12}$. Use a model to solve. (Example 2)

_____

_____

Write and solve an equation. (Example 4)

8. A piece of licorice is to be cut into 10 equal-size pieces. If the length of the piece of licorice is $\frac{2}{3}$ yard, how long will each piece of licorice be?

_____

_____

9 **CCSS** **Use Math Tools** To tie-dye one T-shirt, $\frac{3}{8}$ cup of dye is needed. The table shows the number of cups of each color of dye in Mr. Galvez's art class. How many T-shirts can be made using only orange dye?

_____

_____

Amount of Dye	
Color	**Number of Cups**
red	12
orange	$\frac{3}{4}$

10. **CCSS** **Reason Abstractly** Carlota has $\frac{3}{4}$ ton of mulch she is going to divide evenly among 5 flower beds. How much mulch will each flower bed contain?

_____

11. CCGPS **Reason Abstractly** Complete the Venn diagram to compare and contrast the division and multiplication problems.

$$\frac{1}{3} \div 6 = ? \qquad \frac{1}{3} \times \frac{1}{6} = ?$$
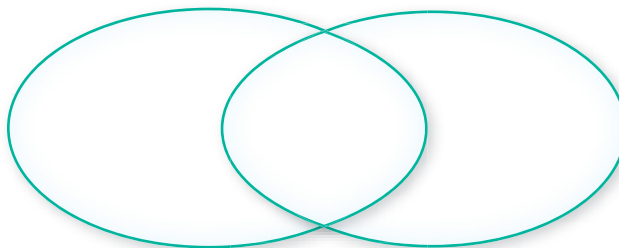
H.O.T. Problems Higher Order Thinking

12. CCGPS **Identify Structure** Find two positive fractions with a quotient of $\frac{5}{6}$.

_____

13. CCGPS **Identify Repeated Reasoning** Is the quotient $\frac{2}{3} \div \frac{1}{2}$ greater than or less than 1? Is the quotient of $\frac{1}{2} \div \frac{2}{3}$ greater than or less than 1? Explain your reasoning. _____

_____

14. CCGPS **Persevere with Problems** Complete the steps to demonstrate why you multiply by the reciprocal when dividing fractions. Find $\frac{1}{4} \div \frac{3}{8}$.

Step 1   Rewrite it as $\dfrac{\frac{1}{4}}{\frac{3}{8}}$.

Step 2   Multiply the numerator and the denominator by the

reciprocal of $\dfrac{\Box}{\Box}$. $\dfrac{\frac{1}{4}}{\frac{3}{8}} = \dfrac{\frac{1}{4} \times \frac{\Box}{\Box}}{\frac{3}{8} \times \frac{\Box}{\Box}}$

Step 3   Simplify the denominator. $\dfrac{\frac{1}{4} \times \frac{8}{3}}{\Box}$

Step 4   Simplify the fraction. $\dfrac{\Box}{\Box} \times \dfrac{\Box}{\Box}$

Georgia Test Practice

15. In cooking, 1 drop is equal to $\frac{1}{6}$ of a dash. If a recipe calls for $\frac{2}{3}$ of a dash, which expression would give the number of drops that are needed?

Ⓐ $\frac{1}{6} + \frac{2}{3}$ Ⓑ $\frac{1}{6} \times \frac{2}{3}$ Ⓒ $\frac{1}{6} - \frac{2}{3}$ Ⓓ $\frac{2}{3} \div \frac{1}{6}$

Extra Practice

Divide. Write in simplest form. Check by multiplying.

16. $\frac{1}{2} \div \frac{2}{3} = \frac{3}{4}$

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

Homework Help →

$= \frac{3}{4}$

$\frac{3}{4} \times \frac{2}{3} = \frac{6}{12} \text{ or } \frac{1}{2}$ ✔

17. $\frac{1}{5} \div 4 = \frac{1}{20}$

$\frac{1}{5} \div 4 = \frac{1}{5} \times \frac{1}{4}$

$= \frac{1}{20}$

$\frac{1}{20} \times \frac{4}{1} = \frac{4}{20} \text{ or } \frac{1}{5}$ ✔

18. $\frac{2}{5} \div \frac{3}{4} =$ _____

19. $\frac{2}{7} \div 2 =$ _____

20. $\frac{1}{5} \div \frac{5}{7} =$ _____

21. $\frac{1}{4} \div \frac{3}{5} =$ _____

22. Write a story context for $\frac{1}{4} \div \frac{1}{8}$. Use a model to solve.

_____

_____

Write and solve an equation.

23. A relay race is $\frac{1}{10}$ kilometer long. Four athletes will run an equal distance to complete the relay. How far does each athlete run?

_____

_____

24. Jalisa is using $\frac{5}{6}$ yard of ribbon to make bows for her party favors. Jalisa needs to make 6 bows. What is the length of the ribbon used for each bow?

_____

_____

25. Reaner Recycling shreds $\frac{7}{8}$ ton of aluminum each day. The machines can shred $\frac{1}{24}$ ton aluminum per cycle. How many cycles will be needed to shred the aluminum?

_____

_____

26. CCGPS **Reason Abstractly** Reaner Recycling collected $\frac{7}{4}$ ton of aluminum last Saturday. If $\frac{7}{8}$ ton of aluminum can be shredded each day, how many days will it take to process what was collected on Saturday?

_____

27. Which of the following numbers, when divided by $\frac{1}{2}$, gives a result less than $\frac{1}{2}$?

(A) $\frac{2}{8}$ (C) $\frac{2}{3}$

(B) $\frac{7}{12}$ (D) $\frac{5}{24}$

28. Short Response You have 60 CD cases that you would like to store on the shelf shown. If each CD case is $\frac{3}{8}$ inch wide, is there enough room on the shelf for the CD cases? Explain why or why not.

24 in.

_____

_____
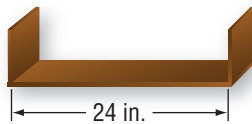
29. The city park service is delivering $\frac{3}{4}$ ton of mulch to 15 parks. Each park will receive an equal amount of mulch. How much mulch does each park receive?

(F) 20 tons (H) $\frac{3}{40}$ ton

(G) $13\frac{1}{3}$ tons (I) $\frac{1}{20}$ ton

30. After a baking contest, $\frac{2}{3}$ of a pie remained. If 8 people get slices of the remainder, how much of the pie does each person get?

(A) $\frac{16}{3}$ (C) $\frac{1}{8}$

(B) $\frac{2}{3}$ (D) $\frac{1}{12}$

Common Core Review

Find the greatest common factor of each pair of numbers. MCC4.OA.4

31. 4 and 8 _____

32. 6 and 3 _____

33. 12 and 8 _____

34. 6 and 8 _____

35. 12 and 16 _____

36. 9 and 15 _____

37. The set department has a 5 foot board. They cut 2 segments that are $1\frac{1}{2}$ foot each. How much of the board is left? MCC4.NF.3d

_____

38. The Sanchez family is building the dog pen shown. What is the area of the dog pen? MCC4.MD.3
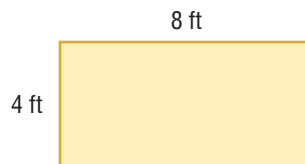
8 ft

4 ft

_____

Divide Mixed Numbers

What You'll Learn

Scan the lesson. Predict two things you will learn about dividing mixed numbers.

• _____

_____

• _____

_____

Real-World Link

Watch ▶

Extreme Geography 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.

1. Write a division expression to find how many times as deep the Mariana Trench is than the average depth of the ocean.

$$\boxed{}\frac{\boxed{}}{\boxed{}} \div \boxed{}\frac{\boxed{}}{\boxed{}}$$

Mariana Trench   Average Ocean Depth

Mt. Everest

Mariana Trench

Average Ocean Depth
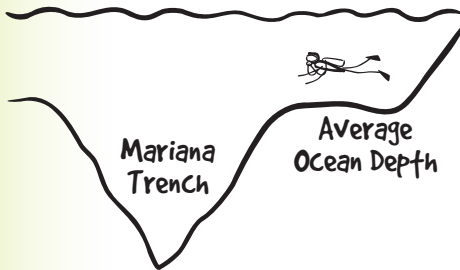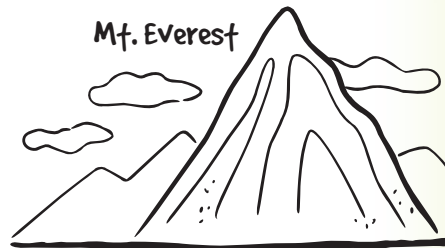
2. Write a division expression to find how many times as tall Mt. Everest is than the average depth of the ocean.

$$\boxed{}\frac{\boxed{}}{\boxed{}} \div \boxed{}\frac{\boxed{}}{\boxed{}}$$

Mount Everest   Average Ocean Depth

3. Rewrite the mixed number $6\frac{4}{5}$ as an improper fraction. $\dfrac{\boxed{}}{\boxed{}}$

4. Rewrite the mixed number $5\frac{1}{2}$ as an improper fraction. $\dfrac{\boxed{}}{\boxed{}}$

Divide a Mixed Number by a Fraction

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.

Examples

Tutor

1. Find $1\frac{3}{4} \div \frac{2}{5}$.

Estimate $2 \div \frac{1}{2} = 4$

$$1\frac{3}{4} \div \frac{2}{5} = \frac{7}{4} \div \frac{2}{5} \qquad \text{Write the mixed number as an improper fraction.}$$

$$= \frac{7}{4} \times \frac{5}{2} \qquad \text{Multiply by the reciprocal.}$$

$$= \frac{35}{8} \text{ or } 4\frac{3}{8} \qquad \text{Simplify.}$$

Check for Reasonableness $4\frac{3}{8} \approx 4$ ✔

· ·

2. Find $3\frac{3}{4} \div \frac{4}{5}$.

Estimate $\boxed{} \div \boxed{} = \boxed{}$

$$3\frac{3}{4} \div \frac{4}{5} = \frac{\boxed{}}{\boxed{}} \div \frac{4}{5} \qquad \text{Write the mixed number as an improper fraction.}$$

$$= \frac{\boxed{}}{\boxed{}} \times \frac{\boxed{}}{\boxed{}} \qquad \text{Multiply by the reciprocal.}$$

$$= \frac{\boxed{}}{\boxed{}} \text{ or } \boxed{}\frac{\boxed{}}{\boxed{}} \qquad \text{Simplify.}$$

Check for Reasonableness $\boxed{}\frac{\boxed{}}{\boxed{}} \approx \boxed{}$ ✔

Show your work.

Got It? Do these problems to find out.

Divide. Write in simplest form. Check by multiplying.

a. $2\frac{3}{8} \div \frac{1}{4}$ **b.** $2\frac{1}{2} \div \frac{3}{7}$ **c.** $5\frac{5}{8} \div \frac{3}{4}$

a. _____

b. _____

c. _____

Divide by a Mixed Number

To divide a mixed number by another mixed number, change both mixed numbers to improper fractions. Remember to simplify before you multiply.

Examples

3. 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.

$$= \frac{11}{5} \text{ or } 2\frac{1}{5}$$ 　　Simplify. Compare to the estimate.

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

Estimate $\boxed{} \div \boxed{} = \boxed{}\dfrac{\boxed{}}{\boxed{}}$

$$4\frac{2}{3} \div 1\frac{3}{4} = \frac{\boxed{}}{\boxed{}} \div \frac{\boxed{}}{\boxed{}}$$ 　　Write the mixed numbers as an improper fractions.

$$= \frac{\boxed{}}{\boxed{}} \times \frac{\boxed{}}{\boxed{}}$$ 　　Multiply by the reciprocal. Divide by the GCF.

$$= \frac{\boxed{}}{\boxed{}} \text{ or } \boxed{}\dfrac{\boxed{}}{\boxed{}}$$ 　　Simplify.

Check for Reasonableness $\boxed{}\dfrac{\boxed{}}{\boxed{}} \approx \boxed{}\dfrac{\boxed{}}{\boxed{}}$ ✔

Got It? Do these problems to find out.

d. $4\frac{1}{5} \div 2\frac{1}{3}$ 　　　**e.** $8 \div 2\frac{1}{2}$ 　　　**f.** $1\frac{5}{9} \div 2\frac{1}{3}$

STOP and Reflect

How is dividing two mixed numbers similar to dividing two fractions?

Show your work.

d. _____

e. _____

f. _____

Example

5. The average adult male Giant Panda weighs about $1\frac{1}{5}$ times as much as the average adult female. If the average weight of a male Giant Panda is 330 pounds, how much does the average female Giant Panda weigh?

To find the average weight, solve the equation $330 \div 1\frac{1}{5} = \blacksquare$.

$330 \div 1\frac{1}{5} = \dfrac{330}{1} \div \dfrac{6}{5}$ Write the mixed number as an improper fraction.

$= \dfrac{330}{1} \times \dfrac{5}{6}$ Multiply by the reciprocal.

$= \dfrac{\overset{55}{\cancel{330}}}{1} \times \dfrac{5}{\underset{1}{\cancel{6}}}$ Divide 330 and 6 by their GCF, 6.

$= \dfrac{275}{1}$ or 275   Simplify.

So, the average female Giant Panda weighs about 275 pounds.
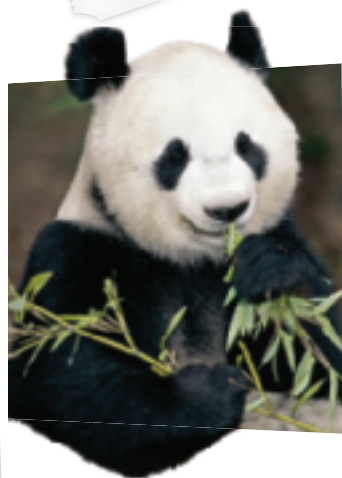
Guided Practice

Check ✓

Divide. Write in simplest form. Check by multiplying. (Examples 1–4)

1. $3\frac{1}{2} \div \frac{1}{2} =$ _____

2. $2\frac{2}{3} \div 1\frac{1}{6} =$ _____

3. $6\frac{2}{3} \div 2\frac{6}{7} =$ _____

Show your work.

4. A box of snack-size cracker packs weighs $28\frac{1}{2}$ ounces. Each snack pack weighs $4\frac{3}{4}$ ounces. How many snack packs are in the box? (Example 5)

_____

5. The soccer team has $16\frac{1}{2}$ boxes of wrapping paper left to sell. If each of the 12 players sells the same amount, how many boxes should each player sell? (Example 5)

_____

6. ⓔ **Building on the Essential Question** How do you divide mixed numbers? _____

_____

_____

Rate Yourself!

☐ I understand how to divide mixed numbers.

▶▶ Great! You're ready to move on!

☐ I still have some questions about dividing mixed numbers.

▥ No Problem! Go online to access a Personal Tutor. | Tutor

FOLDABLES Time to update your Foldable!

Independent Practice

eHelp

Divide. Write in simplest form. Check by multiplying. (Examples 1–4)

1. $4\frac{1}{6} \div 10 =$ _____

Show your work.

2. $6\frac{1}{2} \div \frac{3}{4} =$ _____

3 $3\frac{3}{4} \div 5\frac{5}{8} =$ _____

4. 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? (Example 5)

_____

_____

5 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? (Example 5)

_____

_____

6. **CCSS** **Be Precise** Refer to the graphic novel frame below for Exercises a–c.

a. What is the total weight of the birdseed they bought? _____

b. If each bag contains $1\frac{1}{2}$ pounds, how many bags can they make?

_____

c. Will there be any birdseed left over? Explain. _____

_____

7. **CCSS** **Identify Structure** Complete the steps in dividing mixed numbers.

Divide Mixed Numbers
Is one of the numbers a whole number?

Yes

No

Write the whole number as a _____.

Write the mixed number(s) as _____ fractions.

Write the _____ of the divisor.

Multiply as with _____. Simplify.
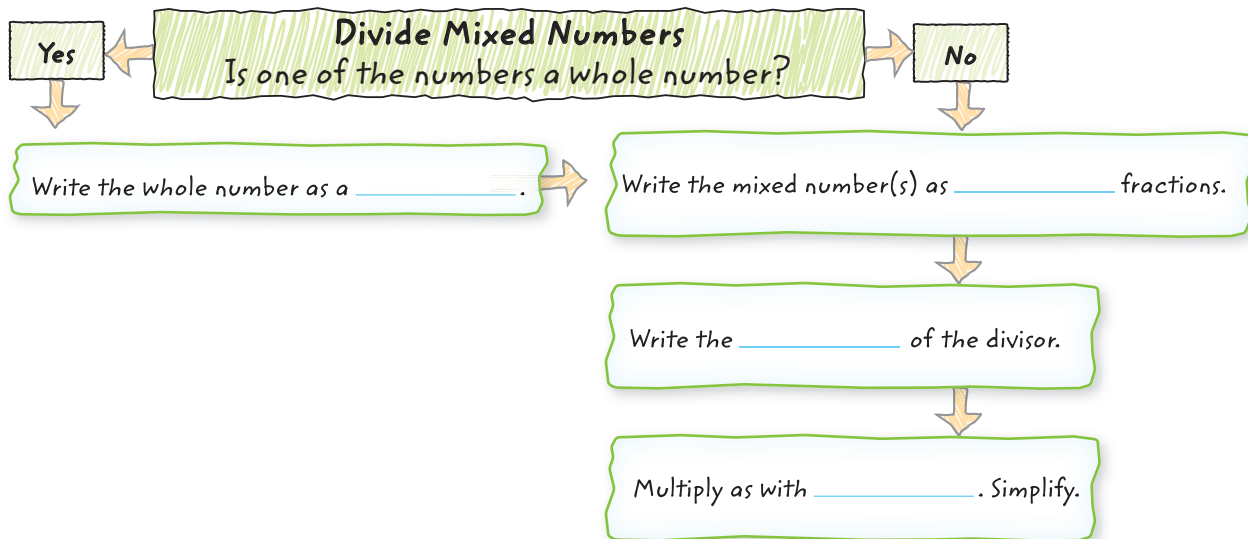
H.O.T. Problems   Higher Order Thinking

8. **CCSS** **Which One Doesn't Belong?** Select the expression that has a quotient greater than 1. Explain your reasoning.

$$4\frac{2}{3} \div 5\frac{1}{4}$$

$$3\frac{1}{8} \div 2\frac{2}{5}$$

$$1\frac{6}{7} \div 2\frac{1}{3}$$

$$5\frac{3}{4} \div 7\frac{3}{8}$$

_____

_____

9. **CCSS** **Persevere with Problems** Without dividing, explain whether $5\frac{1}{6} \div 3\frac{5}{8}$ is greater than or less than $5\frac{1}{6} \div 2\frac{2}{5}$. _____

_____

_____

_____

Georgia Test Practice

10. How many $\frac{3}{4}$-cup servings of cereal can be made from the box of cereal shown?

Ⓐ $8\frac{7}{16}$

Ⓒ 12

Ⓑ $10\frac{1}{2}$

Ⓓ 15

Frosty Puffs

Contains $11\frac{1}{4}$ cups

Extra Practice

Divide. Write in simplest form. Check by multiplying.

11. $5\frac{1}{2} \div 2 = \underline{2\frac{3}{4}}$

$5\frac{1}{2} \div 2 = \frac{11}{2} \div \frac{2}{1}$

$\phantom{5\frac{1}{2} \div 2} = \frac{11}{2} \times \frac{1}{2}$

$\phantom{5\frac{1}{2} \div 2} = \frac{11}{4} \text{ or } 2\frac{3}{4}$

$\frac{11}{\cancel{4}_2} \times \frac{\cancel{2}^1}{1} = \frac{11}{2} \text{ or } 5\frac{1}{2} \checkmark$

Homework Help

12. $3 \div 4\frac{1}{2} = \underline{\hspace{1cm}}$

13. $6 \div 2\frac{1}{4} = \underline{\hspace{1cm}}$

14. $7\frac{4}{5} \div \frac{1}{5} = \underline{\hspace{1cm}}$

15. $6\frac{1}{2} \div 3\frac{1}{4} = \underline{\hspace{1cm}}$

16. $8\frac{3}{4} \div 2\frac{1}{6} = \underline{\hspace{1cm}}$

17. $3\frac{3}{5} \div 1\frac{4}{5} = \underline{\hspace{1cm}}$

18. $6\frac{3}{5} \div 2\frac{3}{4} = \underline{\hspace{1cm}}$

19. $4\frac{2}{3} \div 2\frac{2}{9} = \underline{\hspace{1cm}}$

20. **STEM** A human has 46 chromosomes. This is $5\frac{3}{4}$ times the number of chromosomes of a fruit fly. Write a division expression to find how many chromosomes a fruit fly has.

21. **Reason Abstractly** How many $\frac{3}{8}$-pound bags of trail mix can be made from $6\frac{3}{8}$ pounds of trail mix? Write a division expression.

22. Natasha is setting tiles along the baseboard in her bathroom. One side of the bathroom is $18\frac{3}{4}$ feet. Each tile is $1\frac{1}{2}$ feet long. How many tiles does she need for this section? _____

23. 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?

Ⓐ 2 c

Ⓒ $\frac{5}{9}$ c

Ⓑ $1\frac{4}{5}$ c

Ⓓ $\frac{3}{10}$ c

24. How many $\frac{3}{4}$-ounce samples can be made from the bottle shown?

Ⓕ $7\frac{1}{3}$

Ⓗ 14

Ⓖ $7\frac{7}{8}$

Ⓘ 17

Lotion

10.5 oz

25. Short Response You have a bag that holds $25\frac{1}{2}$ pounds. How many $1\frac{1}{4}$-pound books can the bag hold? Explain your response.

_____

_____

Common Core Review

Multiply. Write in simplest form. MCC5.NF.4

26. $\frac{3}{4} \times 1 =$ _____

27. $\frac{3}{7} \times 2 =$ _____

28. $\frac{1}{2} \times \frac{1}{2} =$ _____

29. $\frac{1}{2} \times \frac{1}{4} =$ _____

30. $\frac{2}{5} \times \frac{1}{4} =$ _____

31. $\frac{3}{4} \times \frac{2}{3} =$ _____

32. Anna is planting corn on her farm. What is the area of cornfield? MCC5.NF.6

_____

$\frac{1}{2}$ mi

$\frac{5}{6}$ mi
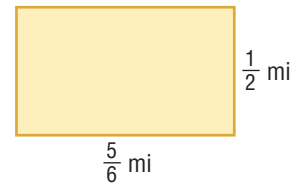
33. Owen has 24 pens and 18 notebooks. He wants to divide the pens and notebooks into equal groups. What is the greatest number of groups he can make using all the pens and notebooks? MCC4.OA.3

_____

Factors and Multiples

What You'll Learn

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

- _____
  _____

- _____
  _____

Vocabulary Start-Up

A *common factor* is a number that is a factor of two or more numbers. The greatest of the common factors of two or more numbers is called the **greatest common factor** (GCF).

The least number that is a multiple of two or more whole numbers is the **least common multiple** (LCM) of the numbers.

Fill in the charts below.

GCF
- stands for:
  _____

Define:
- Greatest
  _____
- Common
  _____
- Factor
  _____

LCM
- stands for:
  _____

Define:
- Least
  _____
- Common
  _____
- Multiple
  _____

Real-World Link

Bryan is making balloon arrangements. He has 8 blue and 12 green balloons. What is the greatest amount of arrangements he can make if he wants them to be identical? _____

Find the Greatest Common Factor

You can use common factors or prime factors to find the GCF.

Real World

Example

Tutor

1. There are one-slice servings of three types of cake on a table. Each row has an equal number of servings and only one type of cake. What is the greatest number of servings in each row?

Cakes	
Type	**Number of Servings**
marble	10
red velvet	15
chocolate	20

To solve this problem, use common factors.

factors of 10: **1**, 2, **5**, 10
factors of 15: **1**, 3, **5**, 15
factors of 20: **1**, 2, 4, **5**, 10, 20   The common factors are 1 and 5.

The GCF of 10, 15, and 20 is 5. So, the greatest number of pieces of cake that can be placed in each row is 5.

Got It? Do this problem to find out.

Show your work.

a. Lana earned $49 on Friday, $42 on Saturday, and $21 on Sunday selling bracelets. She sold each bracelet for the same amount. What is the most she could have charged for each bracelet?

a. _____

Example

Tutor

2. Find the GCF of 12 and 18.

$$12 \qquad\qquad 18$$
$$6 \times 2 \qquad 9 \times 2$$
$$③ \times ② \times 2 \qquad ③ \times 3 \times ②$$

2 and 3 are the common prime factors.
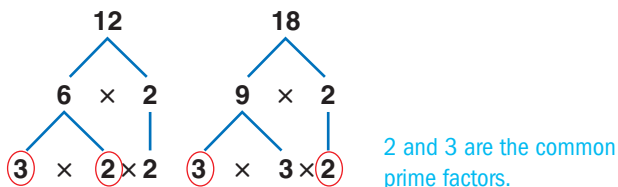
So, the GCF of 12 and 18 is 2 × 3, or 6.

Got It? Do these problems to find out.

Find the greatest common factor of each set of numbers.

b. 12, 66   **c.** 18, 30   **d.** 32, 48

b. _____

c. _____

d. _____

Find the Least Common Multiple

You can find the least common multiple (LCM) by using a number line, making a list, or by using prime factors.

Examples

Tutor

3. **Find the LCM of 2 and 3.**

> **Method 1** **Use a number line.**
>
> Put a red **X** above each multiple of 2 and a blue **X** above each multiple of 3.
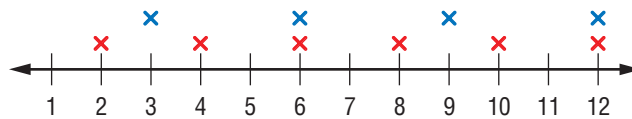
The least number with both a red and a blue X is 6.

So, 6 is the least common multiple of 2 and 3.

> **Method 2** **Use an organized list.**
>
> List the nonzero multiples of 2 and 3.
>
> multiples of 2: 2, 4, **6**, 8, 10, **12**,… $1 \times 2, 2 \times 2, 3 \times 2,…$
>
> multiples of 3: 3, **6**, 9, **12**, 15,… $1 \times 3, 2 \times 3, 3 \times 3,…$

Notice that 6 and 12 are common multiples.

So, the least common multiple of 2 and 3 is 6.

- -

4. **Find the LCM of 14 and 21 using prime factorization.**

Write the prime factorization of each number.

14   **21**
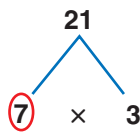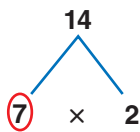
⑦ × **2**   ⑦ × **3**   7 is the only common prime factor.

Multiply using each common prime factor only once.

So, the LCM is 7 × 2 × 3 or 42.

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

Find the least common multiple of each set of numbers.

e. 2, 6   **f.** 4, 5, 10   **g.** 3, 5, 7

Show your work.

e. _____

f. _____

g. _____

Example

5. Ernesto has painting class every 2 weeks. Kamala has a pottery class every 5 weeks. Ernesto and Kamala met at the art building for class this week. How many weeks will it be until they see each other again?

multiples of 2: 2, 4, 6, 8, **10**, 12, 14,…

multiples of 5: 5, **10**, 15, 20, 25, 30,…

The least common multiple of 2 and 5 is 10. So, Ernesto and Kamala will see each other again in 10 weeks.

Guided Practice

Check ✓

Find the greatest common factor of each set of numbers. (Example 1 and 2)

1. 8, 32 _____

2. 24, 60 _____

3. 3, 12, 18 _____

Show your work.

Find the least common multiple of each set of numbers. (Examples 3 and 4)

4. 7, 9 _____

5. 6, 15 _____

6. 9, 12, 15 _____

7. The Movie House gives away a $5 coupon for every 4 movies purchased. They give away a bag of popcorn for every 3 movies purchased. How many movies would you have to purchase in all before receiving both a $5 coupon and a bag of popcorn at the same purchase? (Example 5)

_____

8. ⓔ **Building on the Essential Question** How does finding the greatest common factor help you to solve real-world

problems? _____

_____

_____

Rate Yourself!

Are you ready to move on? Shade the section that applies.
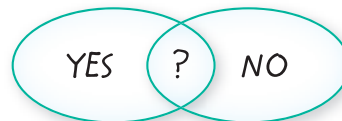
YES   ?   NO

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

Tutor

Independent Practice

Find the greatest common factor of each set of numbers. (Example 2)

1. 8, 14 _____

Show your work.

2. 21, 24, 27 _____

3. 21, 35, 49 _____

4. 12, 18, 26 _____

Find the least common multiple of each set of numbers. (Examples 3 and 4)

5. 5 and 6 _____

6. 6 and 9 _____

7. 6, 12, and 15 _____

8. 3, 9, and 15 _____

9. A gardener has 27 pansies and 36 daisies. He plants an equal number of each type of flower in each row. What is the greatest possible number of pansies in each row? (Example 1)

_____

_____

10. Fourteen boys and 21 girls will be equally divided into groups. Find the greatest number of groups that can be created if no one is left out. (Example 1)

_____

_____

11. Inez waters her plants every two days. She trims them every 15 days. She did both today. When will she do both again? (Example 5)

_____

_____

12. **CCSS** **Identify Repeated Reasoning** An airport offers two shuttles that run on different schedules. If both shuttles leave the airport at 4:00 P.M., at what time will they next leave the airport together?

Shuttle Schedule	
Shuttle	**Departs**
A	every 6 minutes
B	every 9 minutes

_____

_____

H.O.T. Problems Higher Order Thinking

13. **CCSS** **Model with Mathematics** Write and solve a real-world problem that can be solved using the greatest common factor of two numbers.

_____

_____

_____

14. **CCSS** **Identify Repeated Reasoning** How can you use number patterns to find the least common multiple of 120 and 360?

_____

_____

_____

15. **CCSS** **Persevere with Problems** If the GCF of two numbers is 1, they are called _relatively prime._ Find three sets of relatively prime numbers.

_____

_____

_____

Georgia Test Practice

16. There are 36 cans of green beans and 48 cans of corn. The display designer wants an equal number of each vegetable in each row. What is the greatest number of cans of corn that can be in each row?

  Ⓐ 3 cans   Ⓒ 6 cans

  Ⓑ 4 cans   Ⓓ 12 cans

Extra Practice

Find the greatest common factor of each set of numbers.

17. 15, 20 _5_____

> Homework Help

factors of 15: ①, 3, ⑤, 15
factors of 20: ①, 2, 4, ⑤, 10, 20
The common factors are 1 and 5.
The GCF is 5.

18. 30, 48, 60 _____

19. 24, 30, 42 _____

20. 24, 40, 56 _____

Find the least common multiple of each set of numbers.

21. 3 and 5 _15_____

multiples of 3: 3, 6, 9, 12, ⑮, 18, 21, 24, 27, ㉚
multiples of 5: 5, 10, ⑮, 20, 25, ㉚
The common multiples are 15 and 30.
The LCM is 15.

22. 12 and 18 _____

23. 5, 10, and 15 _____

24. 9, 12, and 18 _____

25. A grocery store clerk has 16 oranges, 20 apples, and 24 pears. The clerk needs to put an equal number of apples, oranges, and pears into each basket. What is the greatest number of baskets that can be made so that no fruit is left?

_____

_____

26. **CCGPS** **Identify Repeated Reasoning** The science department buys the equipment shown in the table. They bought all three items this year. In how many years will they have to buy all three items again?

_____

Item	Time Bought
Microscopes	every 5 years
Safety goggles	every 4 years
Test tubes	every 2 years

27. The cafeteria has 28 bottles of orange juice and 14 bottles of apple juice. An equal number of orange and apple juice bottles are displayed in each row. What is the greatest number of orange juice bottles that can be in each row?

Ⓐ 2 bottles   Ⓒ 14 bottles

Ⓑ 7 bottles   Ⓓ 18 bottles

28. Drusilla replaces the light bulb in the hall closet every 9 months and replaces the air filter every 3 months. She just replaced both items this month. How long will it be until she changes both the light bulb and the air filter?

Ⓕ 3 months   Ⓗ 12 months

Ⓖ 9 months   Ⓘ 27 months

29. Short Response Macy is painting a design that contains two repeating patterns. One pattern repeats every 8 inches. The other pattern repeats every 12 inches. If both patterns begin at the same place, in how many inches will they begin together again? _____

_____

_____

Common Core Review

Write each fraction in simplest form. MCC5.NF.5b

30. $\dfrac{9}{18} =$ _____

31. $\dfrac{21}{35} =$ _____

32. $\dfrac{36}{48} =$ _____

33. Josiah ran $\dfrac{4}{5}$ mile. How many tenths are equal to $\dfrac{4}{5}$ mile? Use bar diagrams to find the answer. MCC5.NF.5b

_____

_____

$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{5}$
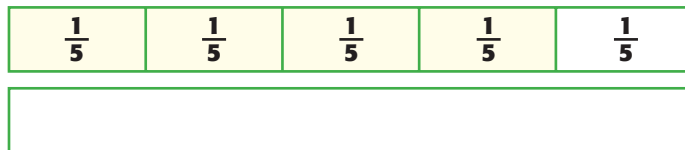
34. Pizza Palace cuts a medium pizza into 8 slices. The same size pizza at Pizza Pioneers is cut into 16 slices. Jasmine ate 4 slices of a medium pizza from Pizza Pioneers. What fraction of the pizza from Pizza Palace is equal to $\dfrac{4}{16}$? Explain. MCC5.NF.5b

_____

21ST CENTURY CAREER
in Culinary Arts

Pastry Chef

Are you creative in the kitchen? Do you enjoy sharing your creations with others? If so, a career as a pastry chef might be perfect for you. Pastry chefs can have different responsibilities, such as creating desserts and dessert menus for restaurants; baking breads, pies, and cakes for neighborhood bakeries; or producing pastries and baked goods for grocery stores. Pastry chefs are not only artistic, but they are also precise and understand mathematics and the chemistry of the ingredients that they are using.

College & Career READINESS

Explore college and careers at **ccr.mcgraw-hill.com**

Is This the Career for You?

Are you interested in a career as a pastry chef? Take some of the following courses in high school to get you started in the right direction.

◆ Algebra
◆ Chemistry
◆ Culinary Operations
◆ Food Science Technology

Find out how math relates to a career in Culinary Arts.

You be the Pastry Chef!

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

1. A chef is making only half of the frosting recipe. How much cream of tartar is needed? How much granulated sugar is needed? _____

2. The petits fours recipe is doubled. How much milk is needed for the cake? _____

3. If the frosting recipe is tripled, how much water is needed? Justify your procedure.

   _____

   _____

4. For a wedding, a pastry chef is increasing the cake recipe by $4\frac{1}{2}$ times. How much butter is needed? flour? _____

5. The recipe is increased to make $1\frac{3}{4}$ times the number of petits four than the original recipe. How much vanilla extract is needed for the cake and the frosting? Justify your procedure.

   _____

   _____

Petits Fours Frosting

3 cups granulated sugar
$\frac{1}{4}$ teaspoon cream of tartar
$1\frac{1}{2}$ cups water
1 cup powdered sugar, sifted
$\frac{1}{2}$ teaspoon vanilla extract
$\frac{1}{2}$ teaspoon almond extract

Petits Fours Cake

$\frac{1}{4}$ cup butter, melted
1 cup shortening
1 cup granulated sugar
1 teaspoon vanilla extract
$1\frac{1}{3}$ cups all-purpose flour
2 teaspoons baking powder
$\frac{1}{2}$ teaspoon salt
$\frac{2}{3}$ cup milk
3 egg whites

Career Project

It's time to update your career portfolio! Use the Internet or another source to research a career as a pastry chef. Write a paragraph that summarizes your findings.

_____

_____

_____

_____

_____

List the strengths you have that would help you succeed in this career.

- _____
- _____
- _____
- _____
- _____

Vocabulary Check Vocab abc

Fill in the blank with the correct vocabulary term. Then (circle) the word that completes the sentence in the word search.

1. A number that has a whole number part and a fraction part is a _____.

2. The _____ is the greatest of the common factors of two or more numbers.

3. The product of a number and its _____ is one.

4. The number above the fraction bar is the _____.

5. The number below the fraction bar is the _____.

6. A _____ is a number that represents part of a whole or part of a set.

7. A _____ is a fraction with a denominator of 1.

8. A fraction with a numerator that is greater than or equal to the denominator is an _____.

9. _____ are numbers that are easy to divide mentally.

10. A fraction in which the GCF of the numerator and the denominator is 1 is written in _____.

N	W	V	B	C	H	H	R	O	D	M	D	C	V	P	H	H	P	R	M	R	M
R	O	T	C	A	F	N	O	M	M	O	C	T	S	E	T	A	E	R	G	E	I
K	I	I	O	S	P	Y	K	J	M	L	B	I	Y	Z	S	Q	O	M	R	B	X
H	D	O	T	M	J	C	G	T	P	H	J	S	C	D	B	F	E	E	H	M	E
D	F	E	Z	C	R	T	Q	P	A	I	G	Y	Q	Y	T	Q	C	P	V	U	D
G	E	H	C	Y	A	B	H	S	J	G	V	G	S	S	N	I	D	E	Q	N	N
X	U	N	I	T	F	R	A	C	T	I	O	N	E	V	P	B	N	C	F	E	U
E	M	J	O	C	M	W	F	N	S	P	V	L	D	R	X	I	Y	B	O	L	M
H	N	G	K	M	S	N	U	R	V	T	P	T	O	P	D	A	Q	B	L	B	B
X	O	W	T	G	I	I	O	K	E	M	N	C	V	U	L	I	V	Y	Z	I	E
B	Z	T	F	W	M	N	X	I	I	P	A	Y	B	W	E	F	L	G	N	T	R
A	X	S	Y	K	Y	C	A	S	T	L	O	I	W	Z	X	M	X	K	L	A	T
T	E	J	K	Q	O	L	P	T	X	C	F	R	I	S	T	K	V	L	A	P	K
R	O	T	A	R	E	M	U	N	O	M	A	Q	P	G	N	C	E	Y	X	M	T
Y	H	W	D	N	X	J	S	M	X	R	X	R	U	M	O	G	K	B	R	O	I
M	F	F	T	B	D	Y	N	A	P	R	G	I	F	J	I	M	V	F	I	C	A

Use Your FOLDABLES®

Use your Foldable to help review the chapter.

Tape here

Tab 3	**Multiply and Divide Fractions**
Tab 2	
Tab 1	

| Example | Example |
| **fraction x mixed number** | **mixed number ÷ fraction** |

Got it?

The problems below may or may not contain an error. If the problem is correct, write a "✓" by the answer. If the problem is not correct, write an "X" over the answer and correct the problem.

1. $13 \times \frac{1}{3} = 4\frac{2}{3}$

The first one is done for you. → $13 \times \frac{1}{3} = \frac{13}{3} \text{ or } 4\frac{1}{3}$

2. $16 \times \frac{5}{6} = 19\frac{1}{5}$

3. $35 \times \frac{3}{7} = 15$

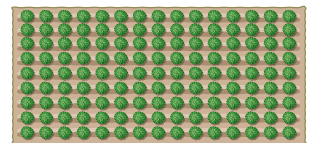**4.** $\frac{5}{8} \div \frac{3}{4} = \frac{15}{32}$

5. $3\frac{2}{3} \div \frac{5}{6} = 4\frac{2}{5}$

6. $2\frac{2}{3} \div 1\frac{1}{4} = 2\frac{2}{3}$

1. A game board measures $9\frac{1}{2}$ inches by $11\frac{3}{4}$ inches. Estimate the area of the game board. (Lesson 1) _____

2. In a two-week period it was sunny $\frac{3}{7}$ of the days. How many days were sunny? (Lesson 2) _____

3. Seven-eighths of the students in Mr. Klingel's class watched television last night. The table lists the fraction of those students that watched each type of show. What fraction of the entire class watched a reality show?

   (Lesson 3) _____
   _____

Type of Show	Fraction of Students
Reality	$\frac{1}{2}$
Sports	$\frac{1}{8}$
Comedy	$\frac{3}{8}$

4. Nathan deposited $\frac{7}{9}$ of his allowance into his savings account. He spent the remaining amount, or $2.50. How much did Nathan deposit into his savings account? (Lesson 3) _____
   _____

5. It is recommended that $\frac{3}{5}$ of the Calories a person consumes come from carbohydrates. If $\frac{1}{12}$ of those Calories should be from fiber, what fraction of the total number of Calories should come from fiber? (Lesson 3) _____
   _____

6. A pancake recipe calls for $2\frac{2}{3}$ cups of flour. If Vonetta wants to make $1\frac{1}{2}$ times the recipe, how much flour does she need? (Lesson 4) _____
   _____

7. **CCGPS** **Be Precise** The largest telescope in the world is powerful enough to identify a penny that is 5 miles away. How many yards is this? (Lesson 5)
   _____

8. Each homeroom of Reedurban Middle School receives a $\frac{1}{12}$-acre plot of the land shown. How many homerooms receive a plot of land?

   (Lesson 7) _____
   _____

   $\frac{5}{6}$ acre

9. 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? (Lesson 8)
   _____
   _____

Reflect

e Answering the Essential Question

Use what you learned about multiplying and dividing fractions to complete the graphic organizer.

e Essential Question

WHAT does it mean to multiply and divide fractions?

Operation	Dividend and Divisor	Is the answer less than or greater than the dividend? Provide an example.
multiply	whole number by whole number	
multiply	fraction by fraction	
divide	whole number by whole number	
divide	fraction by fraction	

e Answer the Essential Question. WHAT does it mean to multiply and divide fractions?

_____

_____

_____

_____