BLOCK 3 ~ FRACTIONS AND DECIMALS

MULTIPLYING AND DIVIDING FRACTIONS

Lesson 13  Multiplying Fractions with Models
Explore! Fraction Action

Lesson 14  Multiplying Fractions

Lesson 15  Dividing Fractions with Models
Explore! What Fits?

Lesson 16  Dividing Fractions

Lesson 17  Estimating Products and Quotients
Explore! 4-H Club

Lesson 18  Multiplying and Dividing Fractions and Whole Numbers

Lesson 19  Multiplying and Dividing Mixed Numbers
Explore! Scrapbooking

Lesson 20  Area with Fractions
Explore! Triangle Area

Review  Block 3 ~ Multiplying and Dividing Fractions

WORD WALL

Quotient  Reciprocal  Dividend  Area  Divisor  Compatible Numbers  Perpendicular
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<th>BLOCK 3 ~ MULTIPLYING AND DIVIDING FRACTIONS</th>
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<td><strong>Advertisements</strong></td>
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<td>Find advertisements that state “Buy One, Get One Half Off.” Figure out the savings for purchases.</td>
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<td>See page 96 for details.</td>
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<td><strong>Multiplication of Multiple Fractions</strong></td>
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<td>Solve multiplication problems with three or more fractions.</td>
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<td>Create a flap book to teach other students how to multiply and divide fractions using models.</td>
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EXPLORE!

Find the value of \( \frac{1}{6} \times \frac{3}{4} \) (which is read \( \frac{1}{6} \) of \( \frac{3}{4} \)) by completing the following steps.

**Step 1:** Divide a piece of paper horizontally into as many sections as are shown in the denominator of one of the factors. For \( \frac{3}{4} \), divide the paper into 4 horizontal sections.

```
   ________
   |       |
   |       |
   |       |
   |       |
```

**Step 2:** Use blue to color in as many horizontal sections as are shown in the numerator. For \( \frac{3}{4} \), color in 3 of the 4 sections.

```
   ________
   |       |
   |       |
   |       |   blue sections
   |       |
```

**Step 3:** Divide the piece of paper vertically into as many sections as are shown in the denominator of the factor. For \( \frac{1}{6} \), divide the paper into 6 vertical sections.

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**Step 4:** Use yellow to color in as many vertical sections as are shown in the numerator. For \( \frac{1}{6} \), color in one of the 6 vertical sections.

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**Step 5:** The answer to your product is \( \frac{\text{number of sections shaded green}}{\text{total number of sections}} \).

\[
\frac{1}{6} \times \frac{3}{4} = \frac{3}{24} \Rightarrow \frac{3}{24} = \frac{1}{8}
\]

Simplify if necessary.

**Step 6:** Repeat **Steps 1-5** by finding the product of at least four different pairs of fractions from the purple box.

**Step 7:** Does it matter which fraction in the equation is shaded first? Explain your reasoning.
**EXAMPLE 1**

Rafael’s mom had $\frac{3}{4}$ cup of blueberries. She split the blueberries among her three children. Each one received $\frac{1}{3}$ of the blueberries. What fraction of a cup of blueberries did each child receive?

**Solution**

Write the problem.

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

Draw a rectangle and divide it into fourths horizontally. Shade $\frac{3}{4}$ of the rectangle, or three of the four sections, with blue.

Divide the rectangle vertically into thirds. Shade $\frac{1}{3}$ of the rectangle, or one of the vertical sections, with yellow.

There are now 12 sections on the rectangle. This is the value of the denominator.

There are 3 sections that were shaded twice. This is the value of the numerator. Simplify.

Each child received $\frac{1}{4}$ cup of blueberries.

**EXAMPLE 2**

Find the value of $\frac{4}{5} \times \frac{2}{3}$ using models.

**Solution**

Draw a rectangle and divide it into thirds horizontally. Shade two of the three sections with blue.

Divide the rectangle vertically into fifths. Shade four of the five vertical sections with yellow.

There are 15 sections on the rectangle. This is the value of the denominator.

There are 8 sections shaded twice. This is the value of the numerator.

The fraction is in simplest form, so $\frac{4}{5} \times \frac{2}{3} = \frac{8}{15}$. 

1. Find the value of $\frac{3}{8} \times \frac{1}{2}$ by completing the following steps.
   
a. Draw a rectangle.
   b. Divide the rectangle horizontally into as many sections as the denominator of the second fraction. Color in as many sections as the numerator of the second fraction.
   c. Divide the square vertically into as many sections as the denominator of the first fraction. Color in as many sections as the numerator of the first fraction.
   d. Write a fraction where the total number of sections is the denominator and the total number of sections that are colored twice is the numerator.
   e. What is the answer in simplest form?

Use the procedure from Exercise 1 to find each product. Write the answer in simplest form.

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

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

Write the equation to match each of the following models. Write the answer in simplest form.

8. $\_ \times \_ = \_ $
9. $\_ \times \_ = \_ $
10. $\_ \times \_ = \_ $

11. A container held $\frac{1}{3}$ cup cream cheese. Becca put $\frac{1}{2}$ of the cream cheese on a bagel. What fraction of a cup of cream cheese did she put on the bagel?

12. About $\frac{7}{10}$ of the Earth's surface is water. The Pacific Ocean makes up $\frac{1}{2}$ of this water. What fraction of the Earth is covered by the Pacific Ocean?

**REVIEW**

Find each difference using renaming. Write in simplest form.

13. $4\frac{1}{3} - 2\frac{3}{4}$
14. $1\frac{2}{5} - \frac{3}{4}$
15. $6\frac{1}{6} - 4\frac{2}{3}$

Find each sum. Write in simplest form.

16. $1\frac{1}{2} + 2\frac{1}{6}$
17. $7\frac{1}{4} + 3\frac{3}{5}$
18. $5\frac{1}{3} + 4\frac{1}{4}$
Olivia’s mom gave her \( \frac{2}{3} \) of an hour to work on her homework with Tessa before they left for the grocery store. Olivia and Tessa used \( \frac{1}{2} \) of that time for math homework. Olivia thought this equaled \( \frac{1}{2} \) hour. Tessa said she was wrong. She said it equaled \( \frac{1}{3} \) hour. Who was correct?

Olivia and Tessa wrote the problem as a mathematical expression.

\[
\frac{1}{2} \text{ of } \frac{2}{3} \rightarrow \frac{1}{2} \times \frac{2}{3}
\]

Remember that the \( \times \) symbol can be read “of.”

**Example 1**

**Find the value of** \( \frac{1}{2} \times \frac{2}{3} \).

**Solution**

Find the products of the numerators and denominators.

Simplify.

\[
\frac{1}{2} \times \frac{2}{3} = \frac{1 \times 2}{2 \times 3} = \frac{1}{3}
\]

When a numerator and denominator of either fraction have a common factor you can simplify before multiplying.

**Example 2**

**Find the value of** \( \frac{1}{8} \times \frac{4}{7} \).

**Solution**

Find a common factor of one numerator and one denominator. The GCF of the numerator, 4, and denominator, 8, is 4.

Divide that numerator and denominator by 4. Write the factor above or below each simplified number in the fractions.

Multiply the numerators and denominators.

\[
\frac{1}{8} \times \frac{4}{7} = \frac{1}{14}
\]
**EXAMPLE 3** Sandeep had $\frac{3}{8}$ cup of yogurt. She put $\frac{4}{9}$ of the yogurt into a smoothie. What fraction of a cup of yogurt did she use in the smoothie?

**SOLUTION**

Write the problem.

\[ \frac{4}{9} \times \frac{3}{8} \]

The GCF of the numerator, 4, and the denominator, 8, is 4.

Divide that numerator and denominator by 4.

\[ \frac{4}{9} \times \frac{3}{8} = \frac{4 \div 4}{9} \times \frac{3 \div 4}{8 \div 4} = \frac{1}{9} \times \frac{3}{8} \]

Write the new fraction expression. The numerator 3 and the denominator 9 have a GCF of 3.

Divide that numerator and denominator by 3.

\[ \frac{1}{3} \times \frac{1}{2} = \frac{1 \times 1}{3 \times 2} \]

Multiply the numerators and denominators.

\[ \frac{1 \times 1}{3 \times 2} = \frac{1}{6} \]

Sandeep put $\frac{1}{6}$ cup of yogurt in her smoothie.

**EXERCISES**

Find each product. Write your answer in simplest form.

1. \( \frac{1}{3} \times \frac{4}{5} \)
2. \( \frac{3}{4} \times \frac{1}{2} \)
3. \( \frac{2}{3} \times \frac{1}{5} \)

4. \( \frac{4}{5} \times \frac{2}{5} \)
5. \( \frac{1}{4} \times \frac{4}{5} \)
6. \( \frac{5}{6} \times \frac{3}{5} \)

7. \( \frac{4}{7} \times \frac{3}{10} \)
8. \( \frac{3}{4} \times \frac{2}{3} \)
9. \( \frac{5}{6} \times \frac{7}{10} \)

10. A cinnamon roll recipe requires $\frac{5}{8}$ cup of raisins. Beth wanted to make $\frac{1}{2}$ of the recipe of cinnamon rolls. She only needed $\frac{1}{2}$ of the raisins. How many cups of raisins does she need for half of the cinnamon roll recipe?

11. Four cheerleaders had mastered $\frac{1}{2}$ of their dance routine. However, Sadie was behind. She had only mastered $\frac{1}{3}$ of what the other four cheerleaders had mastered. How much of the dance routine had Sadie mastered?
Simplify the numbers in each fraction before multiplying. Find each product.

12. \( \frac{1}{15} \times \frac{5}{6} \)  
13. \( \frac{2}{3} \times \frac{3}{5} \)  
14. \( \frac{4}{5} \times \frac{3}{8} \)

15. \( \frac{2}{7} \times \frac{3}{4} \)  
16. \( \frac{1}{5} \times \frac{10}{13} \)  
17. \( \frac{3}{4} \times \frac{12}{13} \)

18. \( \frac{4}{15} \times \frac{3}{8} \)  
19. \( \frac{15}{16} \times \frac{4}{9} \)  
20. \( \frac{6}{7} \times \frac{7}{12} \)

21. Da-Shawn made \( \frac{3}{4} \) of his shots at basketball practice. Trent made \( \frac{2}{3} \) of the number of shots Da-Shawn made. What fraction of shots did Trent make?

22. Camden completed \( \frac{12}{13} \) of his math homework in thirty minutes. Catira completed \( \frac{3}{4} \) of what Camden had completed in the same amount of time. What fraction of math homework had Catira completed in thirty minutes?

23. Raynesha biked for \( \frac{3}{4} \) hour yesterday. Today she plans to bike for \( \frac{5}{6} \) of the amount of time she did yesterday. How long does she plan to bike today?

**REVIEW**

Find the GCF of each pair of numbers.

24. 32 and 48  
25. 20 and 30  
26. 44 and 33

Use the given measurements to find the perimeter of each polygon.

27.  
28. 
29. 

Lesson 14 – Multiplying Fractions  
75
Follow the same procedure for multiplying two fractions when multiplying three or more fractions. Change any mixed numbers to improper fractions before multiplying.

**Method 1:**
Multiply the numerators. Multiply the denominators. Simplify the fraction.

*Example:* \[\frac{1}{2} \times \frac{2}{6} \times \frac{3}{4} = \frac{1 \times 2 \times 3}{2 \times 6 \times 4} = \frac{6}{48} = \frac{1}{8}\]

**OR**

**Method 2:**
Simplify before multiplying. Divide one numerator and one denominator by a common factor. Repeat with other numerators and denominators as applicable. Multiply the numerators and denominators.

*Example:* \[\frac{1}{2} \times \frac{2}{6} \times \frac{3}{4} = \frac{1 \times 1 \times 1}{1 \times 2 \times 4} = \frac{1}{8}\]

Write twenty different fractions or mixed numbers on small pieces of paper. Select three or more fractions and write a multiplication problem with these fractions. Find the product. Repeat ten times using different combinations of fractions. Challenge yourself by selecting a set of four fractions at least twice.
A group of students wanted to play a game of football in an open field. They marked off 100 yards for the entire football field. They needed to know how many 10 yard sections the 100 yard field covered. This can be written in three different ways.

\[
\begin{align*}
10 \div 100 & \quad \text{or} \quad \frac{100}{10} \quad \text{or} \quad 100 \div 10
\end{align*}
\]

The students divided the 100 yards into 10 yard sections. It looked something like this diagram.

The students saw that 100 yards divided by 10 yards gave them 10 sections of 10 yards each.

In each problem, 100 is the dividend, the number being divided. The divisor is 10, the number used to divide. The answer to the problem is called the quotient.

Dividing requires you to find how many groups of one number fit into another number. The same approach applies when dividing fractions.

**Example 1**

Maelynn needs to measure \(\frac{3}{4}\) cup of milk, but only has a \(\frac{1}{4}\) cup measuring cup. How many times will she need to fill it?

**Solution**

Write the problem.

\[
\frac{3}{4} \div \frac{1}{4}
\]

How many times does \(\frac{1}{4}\) fit into \(\frac{3}{4}\)?

Draw a picture that represents the dividend, \(\frac{3}{4}\).

Circle sets that are the size of the divisor, \(\frac{1}{4}\).

Count how many sets of the divisor fit in the dividend to find the quotient. There are 3 circled sets of \(\frac{1}{4}\) in \(\frac{3}{4}\).

\[
\frac{3}{4} \div \frac{1}{4} = 3
\]

Maelynn will need to fill the \(\frac{1}{4}\) cup measuring cup 3 times.
Example 1 shows how to find the quotient of two fractions with the same denominator. What happens if the fractions have unlike denominators? It is necessary, in this case, to rename the fractions so they have common denominators.

**EXAMPLE 2**

Clint needs to make a platform that is $\frac{3}{4}$ inch thick. He has boards that are each $\frac{3}{8}$ of an inch thick. How many boards does he need to make the platform?

**Solution**

Write the problem. $\frac{3}{4} \div \frac{3}{8}$

How many times does $\frac{3}{8}$ fit into $\frac{3}{4}$?

Rename one or both of the fractions so they have common denominators. $\frac{3}{4} = \frac{6}{8}$

Draw a picture that represents the dividend, $\frac{3}{4}$ or $\frac{6}{8}$.

Circle sets that are the size of the divisor, $\frac{3}{8}$.

Count how many sets of the divisor fit in the dividend to find the quotient.

There are 2 circled sets of $\frac{3}{8}$ in $\frac{6}{8}$ or $\frac{3}{4}$.

$\frac{3}{4} \div \frac{3}{8} = 2$

Clint will need two boards, each $\frac{3}{8}$ inch thick, to make a $\frac{3}{4}$ inch thick platform.

**EXPLORE!**

**WHAT FITS?**

Step 1: Choose one expression from the yellow box. (This example uses $\frac{1}{2} \div \frac{1}{8}$.)

Step 2: If the two fractions in this expression have the same denominator, go to Step 3. If the two fractions have unlike denominators, find a common denominator.

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

Step 3: Draw a rectangle. Divide it into as many sections as the denominator of the dividend. If you renamed the dividend in Step 2, use the new fraction.

Step 4: Color in as many sections as the numerator of the dividend.

Step 5: Circle sets of your divisor in your drawing.
Lesson 15 ~ Dividing Fractions With Models

**EXPLAIN!**

**Step 6:** Count how many sets of the divisor are circled in your drawing.

**Step 7:** Write your drawing as an equation with an answer.  
\[ \frac{1}{2} \div \frac{1}{8} = \square \]

**Step 8:** Use Steps 1-7 to find the quotient of at least four different expressions from the yellow box.

**EXERCISES**

1. \( \frac{6}{8} \div \frac{1}{4} \)
   
   a. Rename one or both of the fractions so they have common denominators.
   b. Draw a rectangular model to represent the dividend.
   c. Circle sets in the rectangle that are the size of the divisor.
   d. How many sets of the divisor fit in the dividend? This is the quotient.

Use the procedure from Exercise 1 to find each quotient.

2. \( \frac{4}{6} \div \frac{1}{6} \)
3. \( \frac{4}{7} \div \frac{2}{7} \)
4. \( \frac{9}{10} \div \frac{1}{10} \)

5. \( \frac{6}{10} \div \frac{1}{5} \)
6. \( \frac{6}{9} \div \frac{1}{3} \)
7. \( \frac{8}{12} \div \frac{2}{6} \)

Write the equation to match each of the following models.

8. \[ \underline{\text{____}} + \underline{\text{____}} = \underline{\text{____}} \]
9. \[ \underline{\text{____}} + \underline{\text{____}} = \underline{\text{____}} \]
10. \[ \underline{\text{____}} + \underline{\text{____}} = \underline{\text{____}} \]
11. \[ \underline{\text{____}} + \underline{\text{____}} = \underline{\text{____}} \]
12. \[ \underline{\text{____}} + \underline{\text{____}} = \underline{\text{____}} \]
13. \[ \underline{\text{____}} + \underline{\text{____}} = \underline{\text{____}} \]

14. Treva had a bottle that held \( \frac{9}{16} \) ounces of liquid. She had a \( \frac{3}{16} \) ounce measuring cup. How many measuring cups of liquid would she need to fill her bottle?

15. Taj took a MAX train through Portland for \( \frac{8}{9} \) mile. The MAX train stopped every \( \frac{2}{9} \) mile. How many times did the train stop while Taj was on it?

**CONTINUED**

\[ \frac{1}{2} \div \frac{1}{8} = \square \]

Quotient
16. Jarrod built a tower of blocks that was $\frac{2}{3}$ meter tall. The blocks were each $\frac{1}{15}$ meter tall. How many blocks did he use?

17. Abir’s mom sliced an orange for her. She gave Abir $\frac{2}{3}$ of the orange. Each slice was $\frac{1}{12}$ of the orange. How many slices of orange did Abir have?

**REVIEW**

Find each product. Write your answer in simplest form.

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

19. $\frac{3}{5} \times \frac{5}{8}$

20. $\frac{2}{7} \times \frac{7}{8}$

Find the LCM of each set of numbers.

21. 4, 5

22. 3, 4, 6

23. 3, 5, 6

Find each difference using renaming.

24. $4 \frac{3}{4} - 2 \frac{7}{8}$

25. $5 \frac{1}{8} - 3 \frac{1}{3}$

26. $6 \frac{3}{5} - 2 \frac{11}{15}$

**Tic-Tac-Toe ~ Teach Me!**

Make a flap book by folding a long sheet of paper lengthwise. Cut just to the fold to create two flaps (as shown in the diagram).

Label one flap “Multiplying Fractions Using Models.” Label the other flap “Dividing Fractions Using Models.”

Under the first flap, write directions to teach a classmate how to multiply fractions using models.

Under the second flap, write directions to teach a classmate how to divide fractions using models.

Have a parent or classmate try your directions to see if they work. Make changes to your directions so they are clear and useful, if needed.
DIVIDING FRACTIONS

Lesson 16

Drawing a model to find how many of one fraction fits into another fraction helps visualize the quotient. However, it becomes more difficult when the fractions do not divide evenly into each other. For example: \( \frac{1}{2} \div \frac{3}{8} \).

If you were to draw this as in Lesson 15, your drawing would show that \( \frac{3}{8} \) does not divide evenly into \( \frac{1}{2} \).

Reciprocals are used to divide fractions without models. Two numbers are reciprocals if their product is 1. To find the reciprocal of a fraction, “flip” the fraction. The numerator becomes the denominator and the denominator becomes the numerator.

\[
\frac{3}{5} \quad \text{Reciprocal} \quad \frac{5}{3} \\
\frac{1}{4} \quad \text{Reciprocal} \quad \frac{4}{1}
\]

\[\sqrt{\frac{3}{5} \times \frac{5}{3} = \frac{15}{15} = 1} \quad \sqrt{\frac{1}{4} \times \frac{4}{1} = \frac{4}{4} = 1}
\]

EXAMPLE 1

Find the reciprocals of the following numbers.

a. \( \frac{2}{3} \)  

b. \( \frac{1}{7} \)  

c. \( \frac{5}{6} \)

SOLUTIONS

a. Since \( \frac{2}{3} \times \frac{3}{2} = \frac{6}{6} = 1 \), the reciprocal of \( \frac{2}{3} \) is \( \frac{3}{2} \).

b. Since \( \frac{1}{7} \times \frac{7}{1} = \frac{7}{7} = 1 \), the reciprocal of \( \frac{1}{7} \) is \( \frac{7}{1} \).

c. Since \( \frac{5}{6} \times \frac{6}{5} = \frac{30}{30} = 1 \), the reciprocal of \( \frac{5}{6} \) is \( \frac{6}{5} \).

To divide by a fraction you must multiply by its reciprocal.

**DIVIDING FRACTIONS**

For any numbers \( a, b, c \) and \( d \):

\[
\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}
\]

Lesson 16 – Dividing Fractions 81
EXAMPLE 2

Find the value of \( \frac{1}{2} \div \frac{2}{3} \).

**Solution**

Find the reciprocal of the divisor.

\[
\frac{2}{3} \rightarrow \frac{3}{2} \quad \text{because} \quad \frac{2}{3} \times \frac{3}{2} = 1
\]

Multiply the dividend by the reciprocal of the divisor.

\[
\frac{1}{2} \div \frac{2}{3} = \frac{1}{2} \times \frac{3}{2} = \frac{1 \times 3}{2 \times 2} = \frac{3}{4}
\]

EXAMPLE 3

Yvette climbed \( \frac{1}{2} \) the stairs at her house. Each stair was \( \frac{1}{14} \) of the staircase. How many stairs had she climbed?

**Solution**

Write the problem.

\[
\frac{1}{2} \div \frac{1}{14}
\]

Find the reciprocal of the divisor.

\[
\frac{1}{14} \rightarrow \frac{14}{1} \quad \text{because} \quad \frac{1}{14} \times \frac{14}{1} = \frac{14}{14} = 1
\]

Multiply the dividend by the reciprocal of the divisor.

\[
\frac{1}{2} \div \frac{1}{14} = \frac{1}{2} \times \frac{14}{1} = \frac{1 \times 14}{2 \times 1} = \frac{14}{2} = 7
\]

☑ Check using a model.

Yvette had climbed 7 stairs.

EXAMPLE 4

At the beginning of this lesson you saw a drawing of the model for \( \frac{1}{2} \times \frac{3}{8} \). Find this quotient.

**Solution**

Find the reciprocal of the divisor.

\[
\frac{3}{8} \rightarrow \frac{8}{3} \quad \text{because} \quad \frac{3}{8} \times \frac{8}{3} = \frac{24}{24} = 1
\]

Multiply the dividend by the divisor’s reciprocal.

\[
\frac{1}{2} \div \frac{3}{8} = \frac{1}{2} \times \frac{8}{3} = \frac{1 \times 8}{2 \times 3} = \frac{8}{6}
\]

Simplify.

\[
\frac{8}{6} = \frac{4}{3} = 1 \frac{1}{3}
\]

☑ Check using the model.

\[
\frac{1}{2} \div \frac{3}{8} = 1 \frac{1}{3}
\]

Notice how the model shows the correct answer. There are \( 1 \frac{1}{3} \) red sections circled.
EXERCISES

Find each quotient. Write your answer in simplest form.

1. \( \frac{2}{3} \div \frac{1}{3} \)  
2. \( \frac{6}{7} \div \frac{3}{7} \)  
3. \( \frac{2}{5} \div \frac{1}{10} \)  
4. \( \frac{1}{2} \div \frac{1}{16} \)  
5. \( \frac{4}{5} \div \frac{2}{15} \)  
6. \( \frac{7}{8} \div \frac{1}{8} \)  
7. \( \frac{1}{2} \div \frac{1}{8} \)  
8. \( \frac{3}{4} \div \frac{2}{8} \)  
9. \( \frac{2}{3} \div \frac{2}{9} \)  

10. Shiloh drives \( \frac{3}{4} \) mile to school each day. There is a stop sign every \( \frac{3}{8} \) mile. How many times does Shiloh have to stop on her way to school?

11. When measuring ingredients:
   a. How many \( \frac{1}{4} \) teaspoons make \( \frac{1}{2} \) teaspoon?
   b. How many \( \frac{1}{3} \) cups make \( \frac{2}{3} \) cup?
   c. How many \( \frac{1}{8} \) teaspoons make \( \frac{1}{2} \) teaspoon?
   d. How many \( \frac{1}{8} \) cups make \( \frac{3}{4} \) cup?

Find each quotient. Write your answer in simplest form.

12. \( \frac{4}{9} \div \frac{2}{3} \)  
13. \( \frac{5}{7} \div \frac{1}{2} \)  
14. \( \frac{5}{6} \div \frac{1}{5} \)  
15. \( \frac{5}{9} \div \frac{1}{3} \)  
16. \( \frac{4}{5} \div \frac{1}{3} \)  
17. \( \frac{6}{7} \div \frac{3}{5} \)  
18. \( \frac{1}{2} \div \frac{4}{5} \)  
19. \( \frac{3}{4} \div \frac{1}{2} \)  
20. \( \frac{2}{3} \div \frac{1}{2} \)  

21. Stefan has a board \( \frac{2}{3} \) foot thick. He cuts \( \frac{1}{8} \) foot thick sections out of it. How many sections will he cut?

22. Three-fourths of a cake remains after a birthday party. Each serving is \( \frac{1}{16} \) of the cake. How many servings remain?
Write a division equation that matches each model.

23. \[ \frac{3}{8} + \frac{1}{2} = \]

24. \[ \frac{7}{9} - \frac{1}{3} = \]

Find each sum or difference.

25. \( \frac{3}{8} + \frac{1}{2} \)

26. \( \frac{7}{9} - \frac{1}{3} \)

27. \( 4\frac{2}{5} + 1\frac{1}{3} \)

28. \( 7\frac{1}{3} - 4\frac{1}{4} \)

**Tic-Tac-Toe ~ Cell Phone Plans**

**Step 1:** Look up four different family plans for cell phones. Find the cost of each family plan (rounded to the nearest dollar) and the number of minutes allowed in each family plan.

**Step 2:** Figure out the fraction each person in your family represents.

*Example:* There are five people in your family. The total number of family members would be the denominator. Each person represents \( \frac{1}{5} \).

**Step 3:** Multiply the fraction that represents one person by the total minutes in each cell phone plan. This is the number of minutes you would have if the total minutes were divided evenly among family members.

**Step 4:** Multiply the fraction that represents one person by the total price of each family plan (rounded to the nearest dollar) to find how much each plan costs per person.

**Step 5:** Create a poster to display your results. Choose the plan that you think is the best. Include your reasons for choosing that plan on the poster.
Finding exact answers to problems involving multiplying and dividing fractions takes time and requires the use of paper and pencil. You may not have these things available to you in many real-world situations. **Compatible numbers** are very important when estimating products and quotients. Compatible numbers are numbers that are easy to mentally compute.

**EXPLORE!**

The Barnyard Critters 4-H Club held a fundraiser for their club. Each member raised money separately. The club leader collected all of the money. The pie chart to the right shows the fraction of the money spent on each type of animal the club members raise.

**Step 1:** Parrish collected $28 during the fundraiser. He wants to determine the amount of his money that was spent on goats.
   a. What calculation could Parrish do to find the exact answer?
   b. Parrish wants to estimate the answer in his head. He changed the amount he collected to a number that is compatible with \( \frac{1}{3} \). Which number, 27 or 29, is more compatible with \( \frac{1}{3} \)? Why?
   c. Use this number to determine the approximate amount of Parrish’s funds spent on goats.

**Step 2:** Nichole raised $35. She wants to determine the amount of her money that will be spent on pigs.
   a. What calculation could Nichole do to find the exact answer?
   b. Nichole estimated the answer in her head. What whole number close to 35 is compatible with \( \frac{1}{6} \)? Why?
   c. Use this number to determine the approximate amount of Nichole’s funds spent on pigs.

**Step 3:** The club members raised $149 overall. Approximate the amount of money spent on cows using a compatible number. What number did you choose and why?

**Step 4:** Use your answer from **Step 3**. Which statement would best express your answer and why?

“"The 4-H Club will spend a little less than $____ on cows.”
“"The 4-H Club will spend a little more than $____ on cows.”

**Step 5:** Estimate each of the following calculations using compatible numbers. Explain in words why you chose the numbers you did.

a. \( \frac{1}{3} \times 20 \)  
   b. \( \frac{1}{5} \times 17 \)  
   c. \( 38 \times \frac{1}{8} \)

**Step 6:** Give a real-world situation where compatible numbers can be used to multiply. Make up an example for that situation. Estimate the solution to your situation using compatible numbers.
Lesson 17 ~ Estimating Products And Quotients

**Estimating Using Compatible Numbers**

1. Substitute compatible numbers for one or more whole numbers or mixed numbers in the expression.
2. Find the value of the expression using the compatible numbers.

---

**Example 1**

**Estimate the value of** $\frac{1}{6} \times 20$.

**Solution**

The number 20 cannot be equally divided into sixths.

List the factors of 6.

$6: 6, 12, 18, 24, 30 …$

Substitute the closest compatible number for 20 that is a multiple of 6. Find the value of $\frac{1}{6} \times 18$ by dividing 18 into 6 equal amounts.

$\frac{1}{6} \times 20 \approx 3$

**Example 2**

Johanna has a 53$\frac{1}{4}$ inch long piece of tubing for her science project. The project directions suggest cutting the tubing into 8$\frac{2}{3}$ inch long pieces. About how many pieces will she be able to cut?

**Solution**

Write the problem.

$53 \frac{1}{4} \div 8 \frac{2}{3}$

Round the divisor to the nearest whole number.

$53 \frac{1}{4} \div 9$

Change the dividend to the nearest multiple of the new divisor.

$54 \div 9 = 6$

Johanna will be able to cut approximately 6 pieces of tubing.
Lesson 17  ~  Estimating Products And Quotients

**EXAMPLE 3**

Jack needed about \(5\frac{3}{4}\) cups of dirt for each pot he was filling. He had \(4\frac{1}{4}\) pots left to fill. Approximately how much dirt does he still need?

**Solution**

Use compatible numbers to estimate. \(5\frac{3}{4} \times 4\frac{1}{4}\)

Choose compatible numbers for each mixed number.

Solve the problem. \(6 \times 4 = 24\), so \(5\frac{3}{4} \times 4\frac{1}{4} \approx 24\).

Jack still needs approximately 24 cups of dirt.

**EXERCISES**

1. Estimating is very useful in many situations.
   a. Describe one situation where you would use estimation rather than determining the exact answer.
   b. Describe one situation where you would NOT use estimation and only an exact answer would be appropriate.

2. Define “compatible number” in your own words.

Estimate each product using compatible numbers.

3. \(\frac{1}{2} \times 23\)
4. \(\frac{1}{4} \times 15\)
5. \(\frac{2}{3} \times 19\)

6. \(\frac{1}{6} \times 47\)
7. \(\frac{3}{8} \times 17\)
8. \(\frac{2}{5} \times 11\)

9. Aisha hit 46 pitches in batting practice. One-third of the hits were fly balls. About how many hits were fly balls?

10. Jeb bought 37 tickets for the carnival. He gave \(\frac{1}{6}\) of the tickets to his brother. Approximately how many tickets did Jeb’s brother get?

Estimate each product using compatible numbers.

11. \(6\frac{1}{4} \times 3\frac{1}{8}\)
12. \(5\frac{1}{9} \times 5\frac{6}{7}\)
13. \(4\frac{3}{10} \times 6\frac{5}{6}\)

14. \(9\frac{1}{12} \times 2\frac{7}{9}\)
15. \(7\frac{2}{11} \times 2\frac{1}{5}\)
16. \(3\frac{13}{15} \times 2\frac{2}{9}\)
Estimate each product using compatible numbers.

17. Mica followed a jam recipe that called for \(5 \frac{1}{4}\) cups of sugar. She wanted to make \(5 \frac{3}{4}\) batches of jam. About how much sugar would she need?

18. Joel was filling containers with cement. Each container held about \(9 \frac{1}{8}\) scoops of cement. He had \(6 \frac{8}{9}\) containers left to fill. Estimate how much cement he needs to fill the rest of the containers.

Estimate each quotient using compatible numbers.

19. \(4 \frac{1}{5} \div 1 \frac{5}{6}\)

20. \(20 \frac{7}{9} \div 2 \frac{7}{8}\)

21. \(44 \frac{3}{4} \div 5 \frac{2}{1}\)

22. \(61 \frac{1}{8} \div 10 \frac{2}{15}\)

23. \(43 \frac{1}{4} \div 6 \frac{4}{5}\)

24. \(80 \frac{1}{4} \div 9 \frac{1}{7}\)

25. Eric was a camp chef. He had \(27 \frac{7}{9}\) gallons of milk in the refrigerator. He used about \(3 \frac{5}{8}\) gallons per day. Approximately how many days will pass before he runs out of milk?

26. Zohar took \(35 \frac{3}{4}\) dollars from his bank account. He spent \(4 \frac{1}{5}\) dollars on Tuesday. He continues spending about the same amount each day. About how many days will it be until he needs to get more money?

**REVIEW**

Write each product in simplest form.

27. \(\frac{1}{2} \times \frac{3}{4}\)

28. \(\frac{1}{3} \times \frac{3}{6}\)

29. \(\frac{2}{5} \times \frac{7}{8}\)

Write each quotient in simplest form.

30. \(\frac{7}{8} \div \frac{1}{2}\)

31. \(\frac{1}{2} \div \frac{1}{4}\)

32. \(\frac{5}{6} \div \frac{5}{8}\)

**Tic-Tac-Toe ~ Fraction Bingo**

Design a fraction BINGO game where players must correctly multiply or divide fractions.

**Step 1:** Create 65 fraction multiplication or division problems which have different answers.

**Step 2:** Use the 65 products or quotients from these problems to fill in at least ten BINGO cards with 25 spaces. Put a "free space" in the center space.

**Step 3:** Write a set of directions for your game. Bring the game to math class to play.
J’Marcus was up to bat nine times in his last two baseball games. One-third of his at-bats were hits. He wanted to determine how many hits he had during his nine at-bats. He must find the value of $\frac{1}{3} \times 9$ in order to find the answer. J’Marcus did this by drawing a model.

Each ball represents one of his nine at-bats.

He circled $\frac{1}{3}$ of the balls.

J’Marcus had hits in 3 of his 9 at-bats.

You can multiply or divide fractions and whole numbers using models. You can also follow the procedures you learned earlier in this Block to find the product or quotient. Before multiplying or dividing, you must write the whole number as a fraction.

A whole number can be written as a fraction by putting a 1 in the denominator. Two examples are shown below.

\[ 9 = \frac{9}{1} \quad \quad 15 = \frac{15}{1} \]

J’Marcus could have found how many hits he had in his last nine at bats by multiplying $\frac{1}{3} \times \frac{9}{1}$.

\[ \frac{1}{3} \times \frac{9}{1} = \frac{1 \times 9}{3 \times 1} = \frac{9}{3} = 3 \]

**Multiplying or Dividing Fractions and Whole Numbers**

1. Write the whole number as a fraction with a denominator of 1.
2. Multiply or divide.
3. Write the answer in simplest form.
**EXAMPLE 1**

Five-eighths of Michael’s pitches in his last baseball game were strikes. If he threw 88 pitches, how many of these were strikes?

**Solution**

Write the problem. \( \frac{5}{8} \times 88 \)

Write the whole number as a fraction. \( \frac{5}{8} \times \frac{88}{1} \)

Multiply the fraction. \( \frac{5}{8} \times \frac{88}{1} = \frac{5 \times 88}{8 	imes 1} = \frac{55}{1} = 55 \)

Fifty-five of Michael’s pitches were strikes.

**EXAMPLE 2**

Find \( 7 \div \frac{3}{5} \).

**Solution**

Write the whole number as a fraction. \( \frac{7}{1} \div \frac{3}{5} \)

Divide. \( \frac{7}{1} \div \frac{3}{5} = \frac{7}{1} \times \frac{5}{3} = \frac{7 \times 5}{1 \times 3} = \frac{35}{3} = 11 \frac{2}{3} \)

\( 7 \div \frac{3}{5} = 11 \frac{2}{3} \)

**EXAMPLE 3**

Kaelani needed 3 cups of chocolate chips to make cookies. She only had a \( \frac{1}{4} \) cup measure. How many \( \frac{1}{4} \) cup measures would she need to make 3 cups?

**Solution**

Write the problem. \( 3 \div \frac{1}{4} \)

Model.

Write the whole number as a fraction. \( \frac{3}{1} \div \frac{1}{4} \)

Divide. \( \frac{3}{1} \div \frac{1}{4} = \frac{3}{1} \times \frac{4}{1} = \frac{3 \times 4}{1 \times 1} = \frac{12}{1} = 12 \)

Kaelani needs twelve \( \frac{1}{4} \) cup measures of chocolate chips to equal 3 cups.
EXERCISES

Find each product.

1. \( \frac{1}{4} \times 16 \)  
2. \( \frac{2}{3} \times 15 \)  
3. \( \frac{5}{6} \times 18 \)  
4. \( \frac{3}{7} \times 20 \)  
5. \( \frac{4}{5} \times 12 \)  
6. \( \frac{3}{4} \times 11 \)  

7. The short track speed skating was dominated by South Korea in the 2006 winter Olympics at Torino, Italy. They took \( \frac{5}{12} \) of the 24 medals awarded. How many medals did South Korea win?

8. Southern Oregon University’s 2006-2007 men’s basketball team won \( \frac{2}{3} \) of their 30 games. How many games did they win?

9. Stacia washed windows at an office building. She had 24 windows to wash. At three o’clock Stacia had washed \( \frac{4}{5} \) of the windows. How many windows had she washed so far?

10. A math teacher had 29 homework assignments to correct. She had corrected \( \frac{3}{4} \) of the homework before she went home. How many assignments had she corrected?

Find each quotient.

11. \( 5 \div \frac{1}{2} \)  
12. \( 6 \div \frac{3}{4} \)  
13. \( 9 \div \frac{3}{5} \)  
14. \( 7 \div \frac{3}{4} \)  
15. \( 8 \div \frac{2}{3} \)  
16. \( 3 \div \frac{2}{7} \)  

17. Jessamyn ordered five pizzas. Jessamyn ordered enough so that each person at her party could eat \( \frac{1}{3} \) of a pizza. How many people did she serve?

18. Jed bought six small bags of candy for his class. Each person received \( \frac{1}{4} \) of a bag of candy. How many people got candy?

19. It took 15 gallons of gasoline to fill Reggie’s gas tank. Reggie said his car used \( \frac{2}{3} \) gallon of gas to drive to work and back. How many trips to work and back could Reggie make on one tank of gas?

20. Marita uses \( \frac{3}{4} \) of a jalapeno pepper for each batch of fresh salsa. She has 13 jalapeno peppers. How many batches of salsa can she make?
Measure the sides of each polygon with a customary ruler. Find each perimeter.

21. [Image of a polygon]
22. [Image of a polygon]
23. [Image of a triangle]

Estimate each product or quotient using compatible numbers.

24. \(33 \div 8\)  
25. \(17 \div 3\)
26. \(4\frac{2}{3} \times 8\frac{5}{6}\)
27. \(9\frac{4}{7} \times 2\frac{1}{8}\)
28. \(11\frac{1}{12} \times 3\frac{5}{7}\)
29. \(203 \div 19\frac{1}{9}\)

**Tic-Tac-Toe ~ How Many Minutes?**

Karen spent \(\frac{2}{3}\) hour practicing piano. She practiced a song called “Jazz Time” for \(\frac{1}{2}\) of this time. How many minutes did she spend practicing “Jazz Time”?

Multiply the two fractions to figure out the fraction of an hour she spent practicing “Jazz Time.”

*Example:* \(\frac{1}{2} \times \frac{2}{3} = \frac{2}{6} = \frac{1}{3}\)

Karen spent \(\frac{1}{3}\) hour practicing “Jazz Time.”

In order to figure out how many minutes Karen spent practicing this song, multiply the fraction of an hour by the number of minutes in an hour (60).

*Example:* \(\frac{1}{3} \times 60 = 20\) Karen spent 20 minutes practicing “Jazz Time.”

How many minutes are in…

1. \(\frac{1}{4}\) hour?
2. \(\frac{1}{6}\) hour?
3. \(\frac{1}{10}\) hour?
4. \(\frac{3}{4}\) hour?
5. \(\frac{2}{3}\) hour?
6. \(\frac{7}{12}\) hour?
7. \(\frac{1}{3}\) of \(\frac{1}{2}\) hour?
8. \(\frac{5}{6}\) of \(\frac{1}{2}\) hour?
9. \(\frac{1}{3}\) of \(\frac{1}{4}\) hour?
10. \(\frac{1}{2}\) of \(\frac{1}{6}\) hour?
11. \(\frac{3}{8}\) of \(\frac{2}{3}\) hour?
12. \(\frac{7}{9}\) of \(\frac{3}{4}\) hour?
MULTIPLYING AND DIVIDING MIXED NUMBERS

LESSON 19

You have learned how to find the products and quotients of two fractions or a fraction and a whole number in this Block. You will learn how to find products and quotients of expressions involving mixed numbers in this lesson.

EXPLORE!

Katelyn enjoys putting her photos into scrapbooks. When she works diligently, she completes $3\frac{1}{2}$ pages each hour.

Step 1: Katelyn’s relatives are coming in $2\frac{1}{2}$ hours. Katelyn wants to know how many pages she can finish before they arrive.

a. Write a math problem that will help her determine this.
b. Change each mixed number to an improper fraction and calculate.
c. Simplify the answer. Write it in a complete sentence.

Step 2: Katelyn plans to complete 14 pages of her scrapbook tomorrow. How many hours will it take her?

a. Write the problem.
b. Change both the whole number and mixed number to fractions and calculate.
c. Simplify the answer. Write the answer in a complete sentence.

Step 3: Katelyn spent a total of $9\frac{1}{3}$ hours on her scrapbook last week. How many pages did she complete?

Step 4: Stephen is just learning to scrapbook. He can finish $2\frac{3}{4}$ pages each hour. He worked with Katelyn for the entire $9\frac{1}{3}$ hours last week. How many pages did he complete?

Step 5: Describe in words the steps to take when multiplying or dividing two mixed numbers.

SCRAPBOOKING

MULTIPLYING AND DIVIDING MIXED NUMBERS

1. Write each mixed or whole number as a fraction.
2. Multiply or divide using the improper fractions.
3. Write the answer in simplest form.
EXAMPLE 1  

Find the value of $7\frac{1}{3} \times 1\frac{1}{4}$.

**Solution**

Change each mixed number to an improper fraction.

$\frac{71}{3} = \frac{22}{3}$  
$\frac{11}{4} = \frac{5}{4}$

Rewrite and multiply.

$\frac{11 \frac{22}{3} \times \frac{5}{4}}{\frac{55}{6}} = \frac{55}{6}$

Write as a mixed number.

$\frac{55}{6} = 9\frac{1}{6}$

$7\frac{1}{3} \times 1\frac{1}{4} = 9\frac{1}{6}$

EXAMPLE 2  

Brennan bought $7\frac{3}{8}$ pounds of salmon for his family. Each portion was about $\frac{1}{2}$ pound of salmon. How many portions could he serve?

**Solution**

Write the problem.

$7\frac{3}{8} \div \frac{1}{2}$

Write the mixed number as an improper fraction.

$7\frac{3}{8} = \frac{59}{8}$

Divide.

$\frac{59}{8} \div \frac{1}{2} = \frac{59}{8} \times \frac{2}{1} = \frac{59 \times 2}{8 \times 1} = \frac{118}{8} = 14\frac{6}{8}$

Simplify.

$14\frac{6}{8} = 14\frac{3}{4}$

Brennan could serve $14\frac{3}{4}$ portions of salmon.

To find the reciprocal of a whole number, write the whole number as a fraction over 1. Then “flip” the fraction.

$3 = \frac{3}{1} \quad$ Reciprocal $\quad \frac{1}{3}$

EXAMPLE 3  

Isaac built a tree house for his daughter. He cut a board into 5 equal pieces. How long is each piece of board if the original board was $11\frac{1}{2}$ feet long?

**Solution**

Write the problem.

$11\frac{1}{2} \div 5$

Write each whole and mixed number as an improper fraction.

$11\frac{1}{2} = \frac{23}{2}$  
$5 = \frac{5}{1}$

Multiply by the reciprocal of the divisor.

$\frac{23}{2} \div \frac{5}{1} = \frac{23}{2} \times \frac{1}{5} = \frac{23}{10}$

Change into a mixed number.

$\frac{23}{10} = 2\frac{3}{10}$

Each equal piece of the board is $2\frac{3}{10}$ feet long.
EXERCISES

Find each product. Write each answer in simplest form.

1. \(\frac{21}{8} \times 2\)  
2. \(3 \times \frac{22}{9}\)  
3. \(2\frac{1}{5} \times 5\)

4. \(4\frac{2}{3} \times \frac{4}{5}\)  
5. \(\frac{1}{3} \times \frac{33}{8}\)  
6. \(\frac{5}{6} \times 2\frac{1}{3}\)

7. \(2\frac{2}{5} \times 1\frac{1}{3}\)  
8. \(1\frac{1}{6} \times 3\frac{1}{2}\)  
9. \(5\frac{1}{2} \times 1\frac{1}{3}\)

10. Naomi used \(4\frac{3}{4}\) tablespoons of ground coffee for each pot of coffee she made. She made one pot of coffee each day, Monday through Friday. How many tablespoons of ground coffee did she use altogether?

11. Yani made cookies. He used \(2\frac{1}{4}\) cups of flour per batch of cookies. He made \(3\frac{1}{2}\) batches of cookies. How much flour did he use?

Find each quotient. Write each answer in simplest form.

12. \(6\frac{2}{5} \div 2\)  
13. \(5 \div 1\frac{1}{4}\)  
14. \(9\frac{2}{5} \div 3\)

15. \(3\frac{1}{9} \div 1\frac{1}{3}\)  
16. \(2\frac{5}{6} \div \frac{3}{8}\)  
17. \(4\frac{1}{6} \div \frac{3}{4}\)

18. \(4\frac{8}{9} \div 1\frac{1}{3}\)  
19. \(3\frac{1}{2} \div 1\frac{1}{4}\)  
20. \(5\frac{1}{3} \div 1\frac{2}{3}\)

21. Ty edged a flower bed with paving stones. Each paving stone was \(5\frac{3}{4}\) inches long. The length of the flower bed was \(40\frac{1}{4}\) inches long. How many paving stones did Ty need?

22. J.D. built a tower out of blocks with his nephew. Each block was \(1\frac{3}{4}\) inches tall. They built a \(43\frac{3}{4}\) inch tall tower. How many blocks did they use?

REVIEW

Find each sum or difference. Write each answer in simplest form.

23. \(\frac{4}{5} - \frac{1}{2}\)  
24. \(\frac{3}{4} + \frac{1}{8}\)  
25. \(\frac{1}{2} - \frac{3}{7}\)

Find each product or quotient. Write each answer in simplest form.

26. \(3 \times \frac{2}{3}\)  
27. \(\frac{14}{15} \div \frac{1}{5}\)  
28. \(9 \times \frac{4}{5}\)

29. \(8 \div \frac{3}{4}\)  
30. \(\frac{2}{3} \times \frac{9}{10}\)  
31. \(11 \div \frac{2}{3}\)
**Tic-Tac-Toe ~ Advertisements**

**Step 1:** Look online or in a newspaper for “Buy One, Get One Half Off” advertisements. Find at least five different advertisements. Print them or cut them out.

**Step 2:** Choose an item from one advertisement.

**Step 3:** Record the price of the first item (full price). Round to the nearest dollar.

**Step 4:** Record the price of the second identical item (half-off price). Round to the nearest dollar.

**Step 5:** Find the price per item by averaging the two prices \( \frac{\text{full price} + \text{half price}}{2} \).

**Step 6:** Repeat Steps 2-5 for four more items from different advertisements.

**Step 7:** Use the advertisements and your calculations to make a collage. Display the advertisements, the price of one item, the price of the second item at half-off, and the average price per item.

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**Tic-Tac-Toe ~ Changing Recipes**

**Step 1:** Choose a favorite recipe with at least five ingredients.

**Step 2:** Find the amounts of ingredients needed to cut the recipe in half. Rewrite the recipe using your results.

**Step 3:** Figure out the ingredient amounts you would need for \( 1\frac{1}{2} \) times the recipe. Rewrite the recipe using your results.

**Step 4:** Rewrite the recipe tripling the ingredients.
A builder needs to know how many square feet of siding to buy for one side of a house. A carpet layer needs to know the square footage of a room so carpet can be ordered. An architect finds the square footage on blueprints in order to give final dimensions to the owner of a company wishing to build a new office building.

Area is the number of square units used to cover a surface. A rectangle with an area of 6 square units can also be written as 6 units².

How do the length and width affect the area? One side is 2 units. The other side is 3 units. The area is 6 square units. The area of different shapes can be found using multiplication.

\[2 \times 3 = 6\]

**Example 1**

Find the area of the rectangle.

**Solution**

Area = length \(\times\) width

Area = 4 \(\times\) \(2\frac{1}{2}\)

Change the mixed number and whole number into improper fractions.

\[4 = \frac{8}{2}\text{ and } 2\frac{1}{2} = \frac{5}{2}\]

Multiply.

\[\frac{8}{2} \times \frac{5}{2} = \frac{20}{4} \text{ or } \frac{4}{1} \times \frac{5}{2} = \frac{10}{1}\]

Simplify.

\[\frac{20}{2} = 10 \text{ or } \frac{10}{1} = 10\]

The area of the rectangle is 10 square units or 10 units².
EXAMPLE 2  

Find the area of the square.  

\[
\text{Area} = \frac{1\frac{1}{2}}{1\frac{1}{2}} \times \frac{1\frac{1}{2}}{1\frac{1}{2}} 
\]

Solution

Area = side \times side

\[
\text{Area} = 1\frac{1}{2} \times 1\frac{1}{2}
\]

Change mixed numbers to improper fractions.

\[
1\frac{1}{2} = \frac{3}{2}
\]

Multiply.

\[
\text{Area} = \frac{3}{2} \times \frac{3}{2} = \frac{9}{4}
\]

Simplify.

\[
\frac{9}{4} = 2\frac{1}{4}
\]

The area of the square is \(2\frac{1}{4}\) square feet or \(2\frac{1}{4}\) \(\text{ft}^2\).

EXPLORE!  

TRIANGLE AREA

Step 1: Draw a rectangle on grid paper.

Step 2: Count the number of grid squares that make up the rectangle’s area. Write this to the side of the rectangle as Area = ___ square units.

Step 3: Record the rectangle’s length and width. Label these on the outside of the rectangle.

Step 4: Draw a diagonal line from one corner of the rectangle to the opposite corner to make a right triangle.

Step 5: What do you think is the area of each triangle formed? Explain your reasoning.

The length of the base and the height are used when finding the area of a triangle. The height of a triangle is a perpendicular line segment drawn from the base of the triangle to the opposite vertex. The base and height are perpendicular if they form a right angle where the two line segments meet.
**EXAMPLE 3**  
Find the area of the triangle.

**SOLUTION**

Area = \( \frac{1}{2} \times \text{base} \times \text{height} \)

Change the whole numbers into fractions.

\( 5 = \frac{5}{1} \) and \( 3 = \frac{3}{1} \)

Multiply.

Area = \( \frac{1}{2} \times \frac{5}{1} \times \frac{3}{1} = \frac{15}{2} \)

Simplify.

Area = \( \frac{15}{2} = 7 \frac{1}{2} \)

The area of the triangle is \( 7 \frac{1}{2} \) square inches or \( 7 \frac{1}{2} \text{ in}^2 \).

**EXERCISES**

Use the given measurements to find the area of each rectangle.

1. 2 units
2. 3 \( \frac{1}{2} \) units
3. 2 \( \frac{1}{2} \) units
4. \( \frac{7}{8} \text{ in} \)
5. \( \frac{1}{4} \text{ in} \)
6. \( \frac{3}{4} \text{ in} \)

7. A carpet layer measured the floor in a room to be carpeted. The room was 20 \( \frac{1}{3} \) ft long and 18 \( \frac{3}{4} \) ft wide. What is the area of the floor in this room?

Use the given measurement to find the area of each square.

8. 4 units
9. 2 \( \frac{1}{3} \) units
10. \( 6 \frac{1}{2} \text{ in} \)

11. \( 3 \frac{3}{4} \text{ in} \)
12. \( 1 \frac{1}{8} \text{ in} \)
13. Estaban has an end table with a square top. One side of the top of the table is $3\frac{1}{4}$ ft long. What is the area of the top of Estaban’s table?

Find the area of the triangles using the given heights and bases.

14. 

15. 

16. 

Measure the sides of the following polygons with a customary ruler to the nearest quarter inch. Find the area of each polygon.

17. 

18. 

19. 

20. 

21. 

22. 

23. Two rectangles each have an area of 12 inches. Find the dimensions of two different rectangles that fit this description.

24. Two triangles each have an area of 12 inches. Find the dimensions of two triangles that fit this description.

**REVIEW**

Find each product.

25. $3\frac{1}{3} \times \frac{5}{6}$

26. $2\frac{1}{9} \times 2\frac{1}{2}$

27. $5\frac{1}{2} \times 2$

Find each quotient.

28. $6\frac{1}{5} \div \frac{2}{3}$

29. $2\frac{5}{7} \div \frac{5}{14}$

30. $5\frac{5}{8} \div 1\frac{1}{4}$
Lesson 20 ~ Area With Fractions

**Tic-Tac-Toe ~ Dream House**

**Step 1:** Use grid paper to draw a one-story dream house where the length of each side of a square equals $2\frac{1}{2}$ feet in real life. You must have at least 6 rooms. Make sure at least three rooms have an odd number of squares on the length and/or width.

*Example:*

<table>
<thead>
<tr>
<th></th>
<th>$12\frac{1}{2}$ ft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>15 ft</td>
<td>Game room = $12\frac{1}{2}$ ft $\times$ 15 ft</td>
</tr>
</tbody>
</table>

$$\frac{25}{2} \times \frac{15}{1} = \frac{375}{2} = 187\frac{1}{2}$ ft$^2$  

**Step 2:** Figure out the square footage of each room.

**Step 3:** Calculate the square footage of the entire house.

**Tic-Tac-Toe ~ Landscaping**

**Step 1:** Draw your own backyard landscape with flower beds, or design one. Write the measurements, to the nearest inch, on all sides of each flower bed. Measure your own back yard or check your design measurements with an adult to make sure the measurements are realistic.

**Step 2:** Use advertisements, the internet or information from a home or garden store to choose an edging block to outline each flower bed. Record a drawing of the edging block and the real length.

**Step 3:** How many edging blocks do you need to edge the perimeter of each flower bed in your landscape design?

**Step 4:** How many edging blocks do you need altogether?

**Step 5:** What is the total cost for the edging blocks?

**Step 6:** Display the landscape on a poster. Include the source of your materials along with Steps 1-5 on your poster. Show your calculations on a separate sheet of paper.
Lesson 13 ~ Multiplying Fractions with Models

Write an equation to match each model.

1.\[ \frac{1}{4} \times \frac{1}{2} \]

2.\[ \frac{1}{2} \times \frac{2}{5} \]

3.\[ \frac{2}{3} \times \frac{1}{4} \]

Draw a model to represent each expression. Write the answer to each expression in simplest form.

4. \[ \frac{1}{4} \times \frac{1}{2} \]

5. \[ \frac{1}{2} \times \frac{2}{5} \]

6. \[ \frac{2}{3} \times \frac{1}{4} \]

Lesson 14 ~ Multiplying Fractions

Find each product. Write the answer in simplest form.

7. \[ \frac{2}{3} \times \frac{3}{8} \]

8. \[ \frac{7}{8} \times \frac{1}{4} \]

9. \[ \frac{5}{6} \times \frac{2}{3} \]

10. \[ \frac{4}{5} \times \frac{1}{8} \]

11. \[ \frac{1}{2} \times \frac{3}{5} \]

12. \[ \frac{5}{9} \times \frac{1}{5} \]
13. Izaya washed \( \frac{1}{3} \) of the cars at the car wash. Todd washed \( \frac{3}{8} \) as many as Izaya washed. What fraction of the total cars did Todd wash?

14. Cindy buys \( \frac{1}{3} \) yard of fabric. She only needs \( \frac{2}{3} \) of this fabric for the project she's making. What fraction of a yard will she use?

15. Nadine ate \( \frac{1}{4} \) of a basket of chicken. Suzanne ate \( \frac{1}{3} \) of the amount that Nadine ate. What fraction of the basket of chicken did Suzanne eat?

Lesson 15 ~ Dividing Fractions with Models

Write an equation to match each model.

16. \[ \frac{3}{3} \div \frac{1}{3} \]
17. \[ \frac{4}{4} \div \frac{2}{2} \]
18. \[ \frac{2}{2} \div \frac{1}{1} \]

Draw a model to represent each expression. Write the answer to the equation.

19. \( \frac{3}{8} \div \frac{1}{8} \)
20. \( \frac{4}{5} \div \frac{2}{5} \)
21. \( \frac{2}{3} \div \frac{1}{6} \)

Lesson 16 ~ Dividing Fractions

Find each quotient. Write your answer in simplest form.

22. \( \frac{4}{5} \div \frac{1}{5} \)
23. \( \frac{1}{2} \div \frac{1}{8} \)
24. \( \frac{4}{5} \div \frac{1}{10} \)

25. \( \frac{3}{7} \div \frac{1}{2} \)
26. \( \frac{5}{6} \div \frac{1}{8} \)
27. \( \frac{3}{5} \div \frac{2}{3} \)

28. Jordyn has \( \frac{7}{8} \) of a liter of water. She has bottles that each hold \( \frac{1}{2} \) liter of water. How many bottles can she fill?

29. Evie drives \( \frac{3}{4} \) mile to work each day. She sees students waiting at bus stops every \( \frac{1}{6} \) mile. How many times does she pass students waiting at bus stops on one trip to work?

30. Joseph put \( \frac{3}{4} \) gallon of marinara sauce into jars. Each jar holds \( \frac{1}{8} \) gallon. How many jars of marinara sauce does Joseph have?
Lesson 17 ~ Estimating Products and Quotients

Estimate each product or quotient.

31. \( \frac{1}{2} \times 21 \)  
32. \( 28\frac{1}{6} \div 4\frac{1}{3} \)  
33. \( \frac{1}{8} \times 17 \)  
34. \( 16\frac{1}{9} \div 5\frac{2}{11} \)  
35. \( 71\frac{4}{9} \div 8\frac{2}{9} \)  
36. \( 5\frac{1}{10} \times 3\frac{1}{3} \)

37. Tamira entered a relay race where the team must swim a total of \( 35\frac{1}{3} \) laps. The four members of the team each swam equal distances in the race. About how many laps did each relay team member swim?

38. Nathaniel had 17 carrot sticks. He gave \( \frac{1}{4} \) of the carrot sticks to his brother. Approximately how many carrot sticks did his brother get?

Lesson 18 ~ Multiplying and Dividing Fractions and Whole Numbers

Find each product or quotient. Write in simplest form.

39. \( \frac{1}{8} \times 64 \)  
40. \( \frac{2}{5} \times 20 \)  
41. \( 9 \div \frac{3}{4} \)  
42. \( 15 \div \frac{3}{5} \)  
43. \( \frac{3}{4} \times 34 \)  
44. \( 32 \div \frac{2}{3} \)  
45. \( 25 \div \frac{5}{8} \)  
46. \( \frac{1}{5} \times 22 \)  
47. \( 12 \times \frac{2}{5} \)

48. Mrs. Jenkins tore off 7 pieces of butcher paper to decorate her bulletin boards. Each piece of paper was \( \frac{3}{4} \) of a yard long. What was the total length of paper she tore off?

Lesson 19 ~ Multiplying and Dividing Mixed Numbers

Find each product or quotient. Write in simplest form.

49. \( 5\frac{1}{8} \times \frac{2}{3} \)  
50. \( 5\frac{2}{3} \div 1\frac{1}{2} \)  
51. \( 5\frac{1}{4} \div 2\frac{1}{2} \)  
52. \( 2\frac{1}{8} \div 1\frac{1}{3} \)  
53. \( 3\frac{1}{3} \times 1\frac{2}{3} \)  
54. \( 4\frac{2}{3} \times 2\frac{3}{4} \)

55. Lani is given 19\( \frac{1}{2} \) dollars for lunches. She spends 3\( \frac{1}{4} \) dollars each day. How many days will it be until she runs out of money?

56. Sakaiya uses 4\( \frac{1}{4} \) cups of sugar for every batch of freezer jam. He makes 1\( \frac{1}{2} \) batches of jam. How many cups of sugar does he use?
Lesson 20 ~ Area with Fractions

Use the given measurements to find the area of the following shapes.

57. \[ \text{Rectangle} \quad 2 \frac{1}{4} \text{ in} \times 4 \frac{1}{2} \text{ in} \]

58. \[ \text{Square} \quad 3 \frac{1}{2} \text{ units} \]

59. \[ \text{Triangle} \quad 3 \text{ in} \times 4 \frac{1}{2} \text{ in} \]

60. \[ \text{Triangle} \quad 3 \frac{1}{2} \text{ units} \times 4 \frac{1}{2} \text{ units} \]

61. \[ \text{Rectangle} \quad 6 \frac{1}{2} \text{ units} \times 4 \frac{3}{8} \text{ units} \]

62. \[ \text{Square} \quad 4 \frac{3}{4} \text{ in} \]

Measure the sides of the following polygons, using a customary ruler, to the nearest quarter of an inch. Find the area of each polygon.

63. \[ \text{Square} \]

64. \[ \text{Triangle} \]

65. \[ \text{Rectangle} \]
Julie
Reporter
Portland, Oregon

I am a news reporter. I talk to people to find the latest or most interesting news in my city. Then I write stories for the newspaper and the newspaper website. I also record or videotape people in the news to broadcast on the website. It is a fast-paced job. No two days are ever the same. I also know my city and state very well because reporters are always on the move looking for news.

I use math, including addition, subtraction, percentages and averages, almost every day. Numbers help me understand changes in our city, such as how many new people moved here from another state, or how many people voted for one candidate. Reporters study financial reports to understand if the businesses in our city are doing well or poorly, or if there is enough money to pay for more schools. Numbers don't lie.

I received a Bachelor of Arts degree in journalism to become a journalist. I also studied history. Some reporters study English, geology, political science or law. What we share is a common desire to take complicated information and present it in a way that people can understand. Reporters can also work for television and radio stations. Every city needs reporters. Reporters in small towns may earn $20,000 a year while those in larger cities earn $45,000 to $85,000 per year.

Being a reporter is like holding a magic key to enter any door or world you wish. I can go into a hospital operating room to write a story about a doctor, or ride in an experimental airplane. I can meet famous people. But the most important thing I do is find hidden news that, once it becomes known, makes the world a better place.