Divide with Fractions

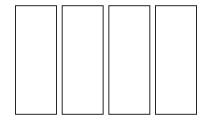**G** **Use What You Know**

In the previous lesson, you learned what dividing by fractions means. In this lesson you will divide with fractions to solve problems. Take a look at this problem.

> Charlie is growing vegetables in planters. He has 4 bags of soil and uses $\frac{2}{3}$ of a bag of soil to fill each planter. How many planters can he fill?

Use the math you already know to solve the problem.

a. Think of the number of planters that Charlie can fill as how many $\frac{2}{3}$s are in 4. Will that number be greater than or less than 4? Explain your reasoning. _____

_____

_____

b. The model below represents the 4 bags of soil. Draw horizontal lines to divide each bag into thirds.

c. Circle and count groups of $\frac{2}{3}$ in the model. How many did you circle? _____

d. Why do you circle groups of $\frac{2}{3}$ to represent this problem? _____

_____

_____

f. How many planters can Charlie fill? _____

g. Explain how the model helped you solve the problem. _____

_____

▶▶ Find Out More

When you found the number of $\frac{2}{3}$s that are in 4, you were dividing. You are solving the problem $4 \div \frac{2}{3}$. You can solve this problem by multiplying.

You know that multiplication and division are related. 4 divided by 2 is the same as $\frac{1}{2}$ of 4, or multiplying 4 by $\frac{1}{2}$.

$4 \div 2 = 2$

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

> Think of 2 as $\frac{2}{1}$. Dividing by $\frac{2}{1}$ is the same as multiplying by $\frac{1}{2}$.

When dividing with unit fractions, you learned that dividing 4 by $\frac{1}{3}$ is the same as multiplying 4 by 3.

$4 \div \frac{1}{3} = 12$

$4 \times 3 = 12$

> Dividing by $\frac{1}{3}$ is the same as multiplying by $\frac{3}{1}$ or 3.

Dividing with any fraction works the same way. Dividing 4 by $\frac{2}{3}$ is the same as multiplying 4 by $\frac{3}{2}$.

$4 \div \frac{2}{3} = 6$

$4 \times \frac{3}{2} = \frac{12}{2}$

$\qquad = 6$

> Dividing by $\frac{2}{3}$ is the same as multiplying by $\frac{3}{2}$.

You can solve any division problem using multiplication. To divide by any number, you can multiply by its **multiplicative inverse**, which is also known as the **reciprocal**.

▶ Reflect

1 Explain how you can solve this division problem by using multiplication.
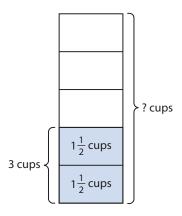
$6 \div \frac{2}{3}$

_____

_____

_____

Learn About ▷ **Dividing a Whole Number by a Fraction**

Read the problem below. Then explore how to divide a whole number by a fraction.

> Kelly drank $\frac{2}{5}$ of the water in her bottle. She drank 3 cups of water. How many total cups of water were in her bottle?

▶ **Picture It You can draw a picture to understand the problem.**

The bar represents Kelly's water bottle. You can divide the bar into fifths and shade $\frac{2}{5}$ to represent the amount of water Kelly drank, 3 cups.
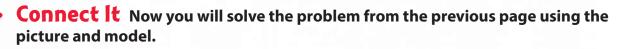

▶ **Model It You can use words and equations to understand the problem.**

$\frac{2}{5}$ of the total amount of water equals 3.

$\frac{2}{5}$	of	**the total amount of water**	equals	**3**
$\frac{2}{5}$	×	**?**	=	**3**

To solve a missing factor problem like $\frac{2}{5} \times ? = 3$, you can divide.

$? = 3 \div \frac{2}{5}$

Connect It Now you will solve the problem from the previous page using the picture and model.

2 Look at *Picture It* on the previous page. Why do you divide the bar into fifths?

_____

_____

3 How can you use *Picture It* to find out how many cups of water were in the bottle?

_____

_____

_____

4 How many total cups of water were in Kelly's bottle? _____

_____

5 Look at *Model It* on the previous page. Find $3 \div \frac{2}{5}$. Show your work. _____

_____

6 Explain how to use multiplication to divide a whole number by a fraction.

_____

_____

_____

Try It Use what you just learned about dividing with fractions to solve these problems. Show your work on a separate sheet of paper.

7 How many $1\frac{1}{2}$-cup servings are there in 12 cups of juice? _____

8 It takes Emily 9 minutes to bicycle $\frac{3}{10}$ of the way to school. How many minutes does it take Emily to bicycle all the way to school? _____

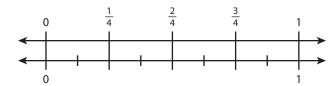**Learn About** ▶ **Dividing a Fraction by a Fraction**

Read the problem below. Then explore how to divide a fraction by a fraction.

Eli ran $\frac{3}{4}$ of a mile. Every $\frac{1}{8}$ of a mile, he jumped over a hurdle. There was a final hurdle at the $\frac{3}{4}$ mile mark. How many hurdles did Eli jump over?

▶ **Picture It** **You can draw a picture to understand the problem.**

The top number line shows the distance Eli ran, $\frac{3}{4}$ mile.

The bottom number line shows the number of $\frac{1}{8}$s that are in $\frac{3}{4}$.

▶ **Model It** **You can use words and equations to understand the problem.**

Think: How many $\frac{1}{8}$s are in $\frac{3}{4}$?

Use division to find how many $\frac{1}{8}$s are in $\frac{3}{4}$.

$\frac{3}{4}$	divided into	$\frac{1}{8}$s	equals	the number of hurdles
$\frac{3}{4}$	÷	$\frac{1}{8}$	=	?

$\frac{3}{4} \div \frac{1}{8} = ?$

Connect It Now you will solve the problem from the previous page using the picture and model.

9 Look at *Picture It*. Why is the top number line divided into fourths? Why is the bottom number line divided into eighths? _____

_____

_____

_____

10 Explain how *Picture It* helps you figure out how many hurdles Eli jumped over.

_____

11 How many hurdles did Eli jump over? _____

12 Look at *Model It*. Explain how to use multiplication to find $\frac{3}{4} \div \frac{1}{8}$. _____

_____

_____

13 Evaluate $\frac{3}{4} \div \frac{1}{8}$. Show your work. _____

14 Explain how to divide a fraction by a fraction. _____

_____

_____

Try It Use what you just learned to solve these problems. Show your work on a separate sheet of paper.

15 Keisha cuts a $\frac{2}{3}$-foot rope into $\frac{1}{12}$-foot pieces. How many pieces of rope did she cut? _____

16 Jade makes half a liter of lemonade. She pours $\frac{1}{10}$ liter of lemonade into each glass. How many glasses is Jade able to fill? _____

Learn About **Dividing a Mixed Number by a Fraction**

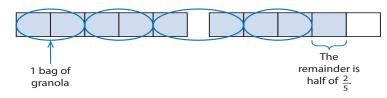**Read the problem below. Then explore how to divide a mixed number by a fraction.**

Mari divides $1\frac{4}{5}$ pounds of granola into $\frac{2}{5}$-pound bags for a bake sale. How many bags of granola can she sell?

▶ **Picture It** **You can draw a picture to understand the problem.**

The shaded bars represent $1\frac{4}{5}$ pounds of granola.

Each circle shows a $\frac{2}{5}$-pound bag of granola.

1 bag of granola

The remainder is half of $\frac{2}{5}$.

▶ **Model It** **You can use words and equations to understand the problem.**

Think: How many $\frac{2}{5}$s are in $1\frac{4}{5}$?

Use division to find how many $\frac{2}{5}$s are in $1\frac{4}{5}$.

$1\frac{4}{5}$	divided into	$\frac{2}{5}$s	equals	the number of bags of granola
$1\frac{4}{5}$	÷	$\frac{2}{5}$	=	?

$1\frac{4}{5} \div \frac{2}{5} = ?$

$\frac{9}{5} \div \frac{2}{5} = ?$

Connect It   Now you will solve the problem from the previous page using the picture and model.

17 Look at *Picture It*. Why do you circle groups of $\frac{2}{5}$ to solve this problem?

_____

_____

18 Count the circles. How many $\frac{2}{5}$-pound bags of granola can Mari sell? _____

19 What fraction of a bag would the remaining $\frac{1}{5}$ pound of granola be? Explain

your answer. _____

_____

_____

20 Look at the *Model It*. Explain how you know $1\frac{4}{5}$ is equal to $\frac{9}{5}$. _____

_____

21 Explain how to use multiplication to evaluate $\frac{9}{5} \div \frac{2}{5}$. _____

_____

_____

22 Evaluate $\frac{9}{5} \div \frac{2}{5}$. Show your work. _____

23 Explain how to divide with mixed numbers. _____

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Try It   Use what you just learned to solve these problems. Show your work on a separate sheet of paper.

24 A recipe requires $\frac{3}{4}$ of a cup of water. Kyle has a $1\frac{1}{2}$-cup measuring cup. How much of

the measuring cup is filled with water? _____

25 How many $\frac{1}{3}$-cup servings are in $\frac{5}{6}$ cup? _____

Practice ▶ **Dividing with Fractions**

Study the example below. Then solve problems 26–28.

Example

Lydia bought $2\frac{1}{2}$ gallons of paint and used $1\frac{1}{2}$ gallons of paint. What fraction of the paint did she use?

Look at how you can show your work using a model.

Think: What fraction of $2\frac{1}{2}$ is $1\frac{1}{2}$?

Some fraction of $2\frac{1}{2}$ equals $1\frac{1}{2}$.

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

To solve $? \times 2\frac{1}{2} = 1\frac{1}{2}$, divide.

$$? = 1\frac{1}{2} \div 2\frac{1}{2}$$

$$= \frac{3}{2} \div \frac{5}{2}$$

$$\frac{3}{2} \div \frac{5}{2} = \frac{3}{2} \times \frac{2}{5}; \frac{3}{2} \times \frac{2}{5} = \frac{6}{10} \text{ or } \frac{3}{5}$$

Solution _Lydia used $\frac{3}{5}$ of the paint she bought._

> The student divided the number of gallons of paint used, $1\frac{1}{2}$, by the gallons of paint she bought, $2\frac{1}{2}$.

> **Pair/Share**
> How could you justify your answer with a picture?

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26 Lexi has planted seeds in $\frac{3}{5}$ of the garden. She used $\frac{1}{2}$ pound of seeds. How many pounds will she use for the entire garden?

Show your work.

> Will the answer be less than 1 or greater than 1? Why?

> **Pair/Share**
> How did you and your partner decide which fraction is the dividend and which is the divisor?

Solution _____

27 A marathon is $\frac{131}{5}$ miles long. If 4 people divide up the distance equally, how many miles does each person need to run?

Show your work.

Solution _____

28 Which of the following problems can be solved by finding $4 \div \frac{2}{3}$?

A 4 people equally share $\frac{2}{3}$ of a pizza. How much of the pizza does each person eat?

B How many $\frac{2}{3}$-cup servings of soup are in 4 cups of soup?

C A pie recipe requires $\frac{2}{3}$ pounds of apples. How many apples are needed for 4 pies?

D A family ate $\frac{2}{3}$ of a 4-foot sandwich. How much did they eat?

Arthur chose **A** as the correct answer. How did he get that answer?

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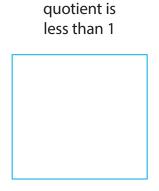**Practice** ▶ **Dividing with Fractions**

Solve the problems.

1 What is the value of the expression $\frac{3}{8} \div 1\frac{1}{2}$?

A $\frac{9}{16}$

B $\frac{6}{8}$

C 4

D $\frac{1}{4}$

2 Find the expression that does NOT answer the question: "What fraction of 8 is $2\frac{1}{2}$?"

A $2\frac{1}{2} \div 8$

B $\frac{5}{2} \times \frac{1}{8}$

C $8 \div 2\frac{1}{2}$

D $? \times 8 = 2\frac{1}{2}$

3 The area and one dimension of a piece of land are given. From the choices on the left, write the fraction inside each box that represents the second dimension of the piece of land described.

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

☐ The area of a rectangular piece of land is $\frac{1}{2}$ square mile. One dimension of this piece of land is $\frac{7}{8}$ mile.

☐ The area of a piece of land that is in the shape of a triangle is $\frac{1}{12}$ square mile. One dimension of this piece of land is $\frac{4}{21}$ mile.

☐ The area of a rectangular piece of land is $\frac{2}{3}$ square mile. One dimension is $1\frac{1}{2}$ miles.
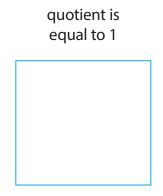
4 Write each expression in the correct column to show whether the quotient is less than, greater than, or equal to 1.

$$\frac{3}{4} \div \frac{1}{2} \qquad \frac{1}{2} \div \frac{3}{4}$$

$$\frac{2}{9} \div \frac{1}{27} \qquad \frac{5}{3} \div \frac{20}{6}$$

$$\frac{4}{3} \div \frac{3}{5} \qquad \frac{19}{8} \div 2\frac{3}{8}$$

quotient is less than 1	quotient is equal to 1	quotient is greater than 1

5 Explain the difference between dividing in half and dividing by half using pictures, models, or numbers.

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6 Write a story to represent the expression $6 \div \frac{3}{4}$. Draw a model and use multiplication to show the solution. Explain how the dividend, divisor, and quotient relate to the story.

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✔ **Self Check** **Go back and see what you can check off on the Self Check on page 51.**