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LESSON 12 Dividing Fractions CCSS: 6.NS.1

1 Introduction

To divide a number by a fraction, multiply by the **reciprocal** of the divisor. The reciprocal of a fraction is its inverse.

Find $\frac{2}{5} \div \frac{3}{5}$.

The divisor is $\frac{3}{5}$. The reciprocal of $\frac{3}{5}$ is $\frac{5}{3}$.

Multiply by the reciprocal: $\frac{2}{5} \times \frac{5}{3} = \frac{10}{15}$

Simplify: $\frac{10}{15} = \frac{2}{3}$

For problems with whole numbers, you can write the whole number as a fraction with 1 as the denominator. You can rewrite mixed numbers as improper fractions as well.

To solve word problems that involve dividing fractions, you can write an equation or draw a fraction model to help you find the answer.

Tammy pours $\frac{2}{3}$ cup of trail mix into a bag. How many $\frac{1}{6}$ -cup servings are in the bag?

Start by writing an equation. The question asks how many groups of $\frac{1}{6}$ are in $\frac{2}{3}$.

$$\frac{2}{3} \div \frac{1}{6} = \square$$

Divide the fractions by multiplying by the reciprocal of the divisor.

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

The bag has 4 servings that are each $\frac{1}{6}$ cup.

To find the reciprocal, flip the numerator and the denominator. The reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$.

To write a mixed number as an improper fraction, multiply the whole number by the denominator. Then add the numerator. The denominator stays the same.

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

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Sometimes when you are multiplying fractions, you can cancel common factors to make it easier to solve.

In the equation on the previous page, you can cancel out the common factor, 3, for 3 and 6:

$$\frac{2}{3} \times \frac{6}{1} = \frac{4}{1} = 4$$

Think About It

Recipes often involve measurements in fraction form. Describe an example of when you might need to divide an amount by a fraction when using a recipe.

2 Focused Instruction

By cancelling common factors, you work with smaller numbers. This makes the operations easier to do.

➤ Find the quotient of $\frac{3}{10} \div \frac{5}{12}$.

Which fraction must you find the reciprocal of? $\frac{5}{12}$

What is the reciprocal of that fraction? $\frac{12}{5}$

Rewrite this division problem as a multiplication problem. $\frac{3}{10} \times \frac{12}{5}$

Look at the denominator of the dividend and the numerator of the divisor. Do these numbers have any common factors? yes

If so, what is the common factor? 2

How many times does the common factor divide each number?
2 divides 10 5 times and 12 6 times.

In your expression above, cross out these numbers and replace them with the number that multiplies the common factor to result in each number.

Look at the numerator of the dividend and the denominator of the divisor. Do these numbers have any common factors? no

Factors are the numbers that are multiplied to get a product.

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Objective

To divide with fractions

1 Introduction

Review how to find the reciprocal of a fraction (flip the numerator and the denominator) and how to multiply fractions (multiply the numerators, then multiply the denominators). Then explain to students that to divide fractions, multiply the dividend by the reciprocal of the divisor. Use the examples on the page to review how to change a mixed number to an improper fraction and how to cross out common factors when multiplying fractions.

Think About It

Students may relate a situation such as dividing a measurement of $2\frac{1}{2}$ cups by $\frac{1}{4}$ because they only have a $\frac{1}{4}$ -cup measuring cup. Whatever situation they describe, they should show understanding of when division of fractions is needed.

Common Core State Standard

6.NS.1 Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem.

Vocabulary

reciprocal: the number by which another number is multiplied to equal a product of 1

2 Focused Instruction

First, students work through a division problem that presents the opportunity to cancel common factors, making it easier to perform the multiplication. Students should recognize that by canceling common factors, they simplify the computation process because they compute with smaller numbers and they do not have to simplify the answer.

Next, students use a fraction model to help them divide. The fraction bar represents 1 whole, so first students divide it in half. Then they divide each half into 5 parts to represent the 5 friends. Since there are a total of 10 parts in the pound and each friend gets 1, each friend gets $\frac{1}{10}$ of a pound. This is the same result as using division.

Conclude the Focused Instruction section by having students solve two division problems.

3 Guided Practice

Students should complete the Guided Practice section on their own. Offer assistance as needed, pointing out the reminder and hint boxes along the right side of the page.

Connections to Standards for Mathematical Practice

- Make sense of problems and persevere in solving them.
- Model with mathematics.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.


2 Focused Instruction Lesson 12

If so, cancel them as you did before. If not, leave them as they are.
 Do the multiplication in your expression. What is the quotient
 of $\frac{3}{10} \div \frac{5}{12}$? $\frac{18}{25}$

How does cancelling common factors help you put the answer in lowest terms?
When I cancel common factors, I do not have to put the answer in lowest terms. It is already in lowest terms. Also, it lets me work with smaller numbers that are easier to multiply.

Sometimes you must divide a fraction by a whole number. You can use a fraction model to help you.

▶ There are 5 friends who are sharing a $\frac{1}{2}$ -pound bag of tortilla chips evenly. What fraction of a pound will each friend get?
 Start by using a fraction model. Show $\frac{1}{2}$ pound on the fraction bar.



Divide the fraction bar to show 5 groups in each part.
 How many smaller sections are there in all? 10
 What fraction of the bar does each smaller section make up? $\frac{1}{10}$
 How much of a pound does each friend get? $\frac{1}{10}$
 Write and solve the same problem as an equation. $\frac{1}{2} \div 5 = \frac{1}{10}$

Use what you know about dividing fractions to solve these problems.

1 $15 \div \frac{3}{4} = \underline{20}$

2 $\frac{3}{8} \div \frac{2}{3} = \underline{\frac{1}{4}}$

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3 Guided Practice Lesson 12

Solve the following problems.

1 Sabrina and Jake are at soccer camp. The length of a soccer practice is $\frac{2}{3}$ hour. The coaches have set aside 8 hours for soccer practice. How many soccer practices can the coaches have?

Part A Write and solve an equation to answer the question.
 Answer $8 \div \frac{2}{3} = 12$

Part B Draw a model of this problem using a fraction bar.



How many smaller sections should each section be divided into?

Part C Explain how the model matches the solution from Part A.
The model shows that there are 12 sections in all, which is represented in the solution to the equation.

2 Carmen walked $2\frac{1}{2}$ miles in $\frac{3}{4}$ hour. What was her average walking speed, in miles per hour?

Speed is measured by distance divided by time.

Answer $3\frac{1}{5}$ miles per hour

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4 Independent Practice

Lesson 12

Solve the following problems.

- 1 A bottle contains 8 cups of juice. The juice is poured into glasses that hold $\frac{3}{4}$ cup each. How many glasses can be filled with the juice? **DOK 2**
6.NS.1

- A 6
- B $8\frac{3}{4}$
- C $10\frac{2}{3}$**
- D 12

- 2 Manuel ordered 6 super-sub sandwiches for a party. Each $\frac{1}{3}$ of a sandwich is 1 serving. Including Manuel, there will be 16 people at the party. Manuel wants to be sure everyone will get at least 1 serving. **DOK 3**
6.NS.1

Part A Draw a number line to illustrate this situation.



Part B Write a division equation to solve this problem.

Answer $6 \div \frac{1}{3} = \square$

Part C Did Manuel order enough food to feed 16 people? Justify your answer.

Yes, Manuel did order enough, because

$$6 \div \frac{1}{3} = \frac{6}{1} \times \frac{3}{1} = \frac{18}{1} = 18.$$

4 Independent Practice Answer Rationales

1 To find the answer, divide 8 by $\frac{3}{4}$: $8 \div \frac{3}{4} = \frac{8}{1} \times \frac{4}{3} = 10\frac{2}{3}$. Choice C is correct. Choice A results when 8 is multiplied by $\frac{3}{4}$. Choice B results when the dividend and the divisor are combined as a mixed number. Choice D results when the quotient is incorrectly simplified.

2 **PART A** The number line should be divided into 6 sections to represent the 6 sandwiches. Each section should be divided into thirds, because each $\frac{1}{3}$ of a sandwich is 1 serving.

PART B The equation should show the total sandwiches divided by amount of 1 serving: $6 \div \frac{1}{3}$.

PART C Calculate the total number of people Manuel can feed and compare it with the people coming to the party: $6 \div \frac{1}{3} = \frac{6}{1} \times \frac{3}{1} = \frac{18}{1} = 18$. Since the sandwiches will feed 18 people and there are 16 people coming, each person will be able to have at least one serving.

Extension Activity

Divide the class into four or five groups. Give each group a container with a fractional amount of a snack (e.g., $\frac{1}{2}$ pound of pretzels, $2\frac{3}{4}$ cups of raisins, etc.). The groups must first divide to find how much each person will get. Then they will use measuring cups or scales to divide the amount evenly and check their answer.

3 PART A Area of a rectangle equals length times width, so dividing the area by the width will give the length. To change each mixed number to an improper fraction, multiply the whole number and the denominator, then add the numerator. The denominator stays the same:

$$1,035\frac{2}{9} = \frac{1,035 \times 9 + 2}{9} = \frac{9,317}{9}; 25\frac{2}{3} = \frac{25 \times 3 + 2}{3} = \frac{77}{3}$$

The equation to find the width is $\frac{9,317}{9} \div \frac{77}{3} = \square$.

PART B Find the reciprocal of the divisor and then multiply: $\frac{9,317}{9} \div \frac{77}{3} = \frac{9,317}{9} \times \frac{3}{77} = \frac{121}{3} = 40\frac{1}{3}$. The width is $40\frac{1}{3}$ feet.

4 The fraction model shows $12 \div \frac{3}{4}$. To find the quotient, multiply by the reciprocal of $\frac{3}{4}$. The whole number 12 is written as a fraction by giving it a denominator of 1. Multiply and cancel common factors: $\frac{4\cancel{12}}{1} \times \frac{4}{\cancel{3}} = 16$.

5 Divide the perimeter of the square by 4: $40\frac{5}{8} \div 4 = \frac{325}{8} \times \frac{1}{4} = \frac{325}{32} = 10\frac{5}{32}$. So each side of the square is $10\frac{5}{32}$ feet long.

6 Speed is found by dividing distance by time ($speed = \frac{d}{t}$): $330\frac{1}{3} \div 5\frac{1}{4} = \frac{991}{3} \times \frac{4}{21} = \frac{3,964}{63} = 62\frac{58}{63}$ miles per hour.

7 The first statement is true, because the reciprocal of a whole number is 1 over the whole number. The second statement is false, because the reciprocal of $\frac{25}{3}$ is $\frac{3}{25}$. The third statement is false. The quotient of $4\frac{1}{2} \div 2$ is $2\frac{1}{4}$, not $2\frac{1}{2}$. The fourth statement is false. The quotient of $\frac{3}{4} \div \frac{8}{3}$ is $\frac{3}{4} \times \frac{3}{8} = \frac{9}{32}$, not 2.

8 To find the size of each piece of land, divide $\frac{2}{3}$ by 3: $\frac{2}{3} \div 3 = \frac{2}{3} \times \frac{1}{3} = \frac{2}{9}$. Choice B is correct. Choice A is the result of dividing $\frac{2}{3}$ by 2, not 3. Choices C and D do not make sense since they show numbers larger than the initial piece of land.

4 Independent Practice Lesson 12

3 The area of a rectangular ice rink is $1,035\frac{2}{9}$ square feet. The length of the ice rink is $25\frac{2}{3}$ feet. **DOK 3 6.NS.1**

Part A Write an equation to find the width of the ice rink. Use improper fractions.

Answer $\frac{9,317}{9} \div \frac{77}{3} = \square$

Part B What is the width of the rink, in feet? Show your work.

$\frac{9,317}{9} \div \frac{77}{3} = \frac{9,317}{9} \times \frac{3}{77} = \frac{121}{3} = 40\frac{1}{3}$

Answer $40\frac{1}{3}$ feet

4 Write and solve a division equation based on the model. **DOK 2 6.NS.1**

Answer $12 \div \frac{3}{4} = \frac{12}{1} \times \frac{4}{3} = \frac{16}{1} = 16$

5 The perimeter of a square is found by multiplying the side lengths by 4. The perimeter of a certain square is $40\frac{5}{8}$ feet. Write and solve an equation to find the length of one side of the square. Show your work. **DOK 2 6.NS.1**

$4s = 40\frac{5}{8}$

$s = 40\frac{5}{8} \div 4 = \frac{325}{8} \times \frac{1}{4} = \frac{325}{32} = 10\frac{5}{32}$

Answer $10\frac{5}{32}$ feet

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4 Independent Practice Lesson 12

6 How fast is a car going that traveled $330\frac{1}{3}$ miles in $5\frac{1}{4}$ hours? Show your work. **DOK 2 6.NS.1**

$s = \frac{d}{t} = \frac{330\frac{1}{3}}{5\frac{1}{4}}$

$s = 330\frac{1}{3} \div 5\frac{1}{4} = \frac{991}{3} \times \frac{4}{21} = \frac{3,964}{63} = 62\frac{58}{63}$

Answer $62\frac{58}{63}$ miles per hour

7 Mark True or False for each of the following statements. **DOK 2 6.NS.1**

	True	False
The reciprocal of 38 is $\frac{1}{38}$.	<input checked="" type="checkbox"/>	<input type="checkbox"/>
The reciprocal of $\frac{25}{3}$ is $3\frac{2}{5}$.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
The quotient of $4\frac{1}{2} \div 2$ is $2\frac{1}{2}$.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
The quotient of $\frac{3}{4} \div \frac{8}{3}$ is 2.	<input type="checkbox"/>	<input checked="" type="checkbox"/>

8 A piece of land is $\frac{2}{3}$ acre. It is divided evenly into 3 pieces. What is the size of each piece of land? **DOK 2 6.NS.1**

A $\frac{1}{3}$ acre

B $\frac{2}{9}$ acre

C 2 acres

D $2\frac{1}{3}$ acres

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