LESSON 24   Divide Unit Fractions in Word Problems

Purpose In this session students draw on their understanding of what it means to divide with unit fractions. They share models to explore how to represent problem situations with visual models. They will look ahead to think about equations they can use to represent and solve these types of problems.

Start

Connect to Prior Knowledge

Why Support students’ facility with using a visual model to represent division of a whole number by a unit fraction.

How Have students copy and then complete a number line model to represent the expression $2 \div \frac{1}{5}$. Discuss that the quotient is 10 and that this means there are 10 groups of $\frac{1}{5}$ in 2.

Look for Number lines should show each whole divided into fifths, so there are 10 fifths in all.

Copy and complete the model to show $2 \div \frac{1}{5}$.

Try It

Make Sense of the Problem

To support students in making sense of the problem, have them identify that there are water stops at half-mile intervals along the 6-mile race route. The first water stop is at the half-mile mark and the last one is at the 6-mile mark.

Discuss It

Support Partner Discussion

Encourage students to use the Discuss It question and sentence starter on the Student Worktext page as part of their discussion.

Look for, and prompt as necessary for, understanding of:

- 6 as the number of wholes
- $\frac{1}{2}$ as the equal-size parts each whole is divided into

Common Misconception Look for students who are not comfortable interpreting the location of water stops at every half mile as including water stops at whole-number miles as well as at $\frac{1}{2}$ mile, $\frac{3}{2}$ miles, $2\frac{1}{2}$ miles, and so on. As students present solutions, have them specify how far beyond the first water station the second water station is and where along the race route it is located.

Select and Sequence Student Solutions

One possible order for whole class discussion:

- physical parts showing wholes and halves
- drawings to represent the problem
- number lines marked in wholes and halves
- division or multiplication equations showing 12 water stops in all

Support Whole Class Discussion

Prompt students to note the relationship between the numbers in each model and the numbers in the problem.

Ask How do [student name]'s and [student name]'s models show the number of wholes? The number of parts in each whole?

Listen for 6 is the number of wholes. Each part is $\frac{1}{2}$, so there are 2 in each whole.
CONNECT IT

1 LOOK BACK

Look for understanding that you can show the 6 miles of the race on the number line, mark each \( \frac{1}{2} \) mile along it to represent the location of a water stop, showing there are 12 water stops in all.

Hands-On Activity

Use fraction bars for fraction division.

If . . . students are unsure about using visual models to show division with fractions,

Then . . . use this activity to make a model.

Materials  For each student: Activity Sheet Fraction Bars (6 wholes)

- Distribute fraction bars. Explain to students that each bar represents 1 mile of the race.
- Prompt students to identify the water stops for the first mile are at \( \frac{1}{2} \) mile and 1 mile. Have them fold one fraction bar in half, open it, and label one water stop on the fold and one at the end of the fraction bar.
- Guide students to see the stops for the first mile represent the location of stops for each mile. Have them fold and mark the other fraction bars accordingly.
- Have students arrange the fraction bars end-to-end and count the water stops along the route, confirming there are 12 water stops.
- Repeat activity for additional division expressions, such as \( 3 \div \frac{1}{2} \) and \( 4 \div \frac{1}{4} \).

2 LOOK AHEAD

Point out that you can also model and solve problems involving dividing whole numbers by unit fractions using division or multiplication equations.

Ask  Why in one equation is the number of miles, 5, divided by the fraction \( \frac{1}{3} \), and in the other equation 5 is multiplied by \( \frac{1}{3} \)?

Listen for  The division equation represents dividing the 5-mile race into \( \frac{1}{3} \)-mile segments to find how many \( \frac{1}{3} \) there are in all; the multiplication equation represents multiplying the number of water stops in one mile, 3, by the number of miles in the race, 5.

Close: Exit Ticket

3 REFLECT

Look for understanding of what it means to divide a whole number by a unit fraction. Student responses should include references to finding how many parts equal in size to the unit fraction there are in a given number of wholes.

Common Misconception  If students think that the quotient cannot be greater than the dividend, then have them write the quotients for the following expressions: \( 6 \div \frac{1}{3} \), \( 6 \div 2 \), \( 6 \div 1 \) and discuss the patterns they see. Have them extrapolate from the pattern how the quotient compares to the dividend when the divisor is less than 1.

Real-World Connection

Encourage students to think about everyday places or situations where people might need to divide with unit fractions. Have volunteers share ideas. Examples: food preparation, construction, physical training.
Solutions

Support Vocabulary Development

1. Have students discuss models they know. Then ask them to share what they know about fractions. Ask: How can you represent a fraction? Have students think of shapes they can divide into equal parts. Then ask them to draw the shape and show how to divide it into equal parts. As students write examples in the graphic organizer, ask them to identify how the whole and the fraction are represented.

2. Read the problem. Ask: How many wholes do you need to divide? Have students draw a model to show the 4 wholes. Then ask: How do you divide each whole into parts of size $\frac{1}{2}$?

Supplemental Math Vocabulary

- bar diagram
- number line

Prepare for Dividing Unit Fractions in Word Problems

1. Think about what you know about fraction models. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can. Possible answers:

   **What Is It?**
   a visual model that represents a fraction

   **What I Know About It**
   I can use a rectangle, a circle, or a number line to represent a fraction.

   ![Fraction Models](image)

2. Draw a fraction model to show the expression $4 \div \frac{1}{2}$.

   Possible answer:
   ![Fraction Model](image)
3  Assign problem 3 to provide another look at dividing with unit fractions in word problems. This problem is very similar to the problem about Micah running a 6-mile race. In both problems, students are asked to draw a visual model to help them to divide a whole number by a unit fraction. The question asks how many pieces of ribbon are there in all. Students may want to use fraction bars, number lines, string, or ribbon. Suggest that students read the problem three times, asking themselves one of the following questions each time:
• What is this problem about?
• What is the question I am trying to answer?
• What information is important?

Solution:
2 ÷ \( \frac{1}{4} \) = 2 × 4 = 8. Check that models show 8 pieces.

Medium

4  Have students solve the problem a different way to check their answer.

Prepare for Session 2

Use with Apply It.

Assign problem 3 to provide another look at dividing with unit fractions in word problems. This problem is very similar to the problem about Micah running a 6-mile race. In both problems, students are asked to draw a visual model to help them to divide a whole number by a unit fraction. The question asks how many pieces of ribbon are there in all. Students may want to use fraction bars, number lines, string, or ribbon. Suggest that students read the problem three times, asking themselves one of the following questions each time:
• What is this problem about?
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Solution:
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Medium

Have students solve the problem a different way to check their answer.

≥Lesson 24  Divide Unit Fractions in Word Problems

3  Solve the problem. Show your work.

Adela has a ribbon that is 2 yards long. She cuts the ribbon into pieces that are \( \frac{1}{4} \) yard long. How many pieces of ribbon are there in all? Use a visual model to show your solution.

Possible student work using a picture:

\[
\begin{array}{c}
\text{2 yd} \\
\hline
\text{2} \\
\hline
\text{1} \\
\hline
\text{3} \\
\hline
\text{5} \\
\hline
\text{4} \\
\hline
\end{array}
\]

Possible student work:

2-yard ribbon with 4 pieces for each yard

\[
\begin{array}{c}
0 \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
2 \\
\hline
\end{array}
\]

\[2 ÷ \frac{1}{4} = 2 × 4 = 8\]

There are 8 pieces of ribbon in all.

4  Check your answer. Show your work.

Preparation for Session 2

Use with Apply It.

Assign problem 3 to provide another look at dividing with unit fractions in word problems. This problem is very similar to the problem about Micah running a 6-mile race. In both problems, students are asked to draw a visual model to help them to divide a whole number by a unit fraction. The question asks how many pieces of ribbon are there in all. Students may want to use fraction bars, number lines, string, or ribbon. Suggest that students read the problem three times, asking themselves one of the following questions each time:
• What is this problem about?
• What is the question I am trying to answer?
• What information is important?

Solution:
2 ÷ \( \frac{1}{4} \) = 2 × 4 = 8. Check that models show 8 pieces.

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≥Lesson 24  Divide Unit Fractions in Word Problems

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Adela has a ribbon that is 2 yards long. She cuts the ribbon into pieces that are \( \frac{1}{4} \) yard long. How many pieces of ribbon are there in all? Use a visual model to show your solution.

Possible student work using a picture:

\[
\begin{array}{c}
\text{2 yd} \\
\hline
\text{2} \\
\hline
\text{1} \\
\hline
\text{3} \\
\hline
\text{5} \\
\hline
\text{4} \\
\hline
\end{array}
\]

Possible student work:

2-yard ribbon with 4 pieces for each yard

\[
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0 \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
\frac{1}{4} \\
\hline
2 \\
\hline
\end{array}
\]

\[2 ÷ \frac{1}{4} = 2 × 4 = 8\]

There are 8 pieces of ribbon in all.
**LEON 24**

**SESSION 2 Develop**

**Purpose** In this session students solve a problem that requires dividing $\frac{1}{6}$ by 3. Students model the numbers in the word problem either on paper or with manipulatives to develop strategies for solving word problems that involve dividing a unit fraction by a whole number.

**Start**

**Connect to Prior Knowledge**

**Why** Support students’ facility with using a visual model to represent division of a unit fraction by a whole number.

**How** Have students copy and then complete a fraction bar model to represent the quotient $\frac{1}{5} \div 2$. Discuss that the quotient is $\frac{1}{10}$.

**Look for Models**

Copy and complete the model to show $\frac{1}{5} \div 2$.

[Blank fraction bar model]

**Develop Language**

**Why** Clarify understanding of the word *border* as it relates to the perimeter or length around an object.

**How** Explain that to *make a border around* something means to put something around its edge. Model with a ribbon, yarn, or a measuring tape and a shape or classroom object. Have students find the word in the Try It problem. Ask: What is Piper using to make a border around the triangle?

**TRY IT**

**Make Sense of the Problem**

To support students in making sense of the problem, have them identify an equilateral triangle as one that has equal-length sides.

**Ask** What is the whole length of ribbon Piper has? How many pieces does she need?

**TRY IT**

Piper uses $\frac{1}{3}$ yard of ribbon to make a border around an equilateral triangle. How long is the piece of ribbon that Piper uses for each side?

For each side, Piper uses a piece of ribbon that is $\frac{1}{18}$ yard long.

**Math Toolkit**

- fraction bars
- fraction models
- number lines
- grid paper
- ribbon or yarn
- index cards

**Possible student work:**

Sample A

Each piece of ribbon is $\frac{1}{3}$ of $\frac{1}{6}$.

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

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

For each side, Piper uses a piece of ribbon that is $\frac{1}{18}$ yard long.

Sample B

Use a rectangle to represent 1 whole yard of ribbon.

The whole is divided into 18 equal parts.

Piper uses a $\frac{1}{18}$-yard-long piece of ribbon for each side.

**DISCUSS IT**

**Ask your partner:** How did you get started? 

**Tell your partner:** I knew ... so I ...

**Support Partner Discussion**

Encourage students to name the model or strategy they used as they discuss. Support as needed with questions such as:

- How would you describe your model?
- How is your model similar to your partner’s?

**Common Misconception**

Look for students who confuse the dividend and divisor and find $3 \div \frac{1}{6}$ instead of $\frac{1}{6} \div 3$. As students present solutions, have them specify the quantity being divided and the number of parts it is divided into.

**Select and Sequence Student Solutions**

One possible order for whole class discussion:

- physical parts showing fifths, thirds, and fifteenths
- drawings to represent the problem
- number lines marked to show the fractions
- division or multiplication equations showing a ribbon length of $\frac{1}{18}$ yard
EXPLORE DIFFERENT WAYS TO UNDERSTAND DIVIDING A UNIT FRACTION BY A WHOLE NUMBER TO SOLVE WORD PROBLEMS.

Piper uses \( \frac{1}{6} \) yard of ribbon to make a border around an equilateral triangle. How long is the piece of ribbon that Piper uses for each side?

**PICTURE IT**

You can draw a picture to help understand the problem.

Draw a 1-yard length of ribbon and then draw and label a \( \frac{1}{6} \) yard length.

**MODEL IT**

You can use equations to model the problem.

Write a division equation.

\[
\frac{1}{6} \div 3 = s
\]

Write a multiplication equation.

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

DEEPEN UNDERSTANDING

**Equation Model**

SMP 2 Reason abstractly and quantitatively.

Prompt students to consider how the equations in Model It reflect different ways to represent the relationship between the quantities in the problem.

**Ask** How does the equation \( \frac{1}{6} \div 3 = s \) represent the ribbon in the problem? Explain the meaning of each number, \( \frac{1}{6} \) and 3, and why the operation is division.

**Listen for** \( \frac{1}{6} \) represents the \( \frac{1}{6} \) yard of ribbon that Piper uses. The triangle is an equilateral triangle, so each side is the same length. That means Piper needs to divide the \( \frac{1}{6} \) yard of ribbon into 3 equal parts, or \( \frac{1}{6} \div 3 \).

**Ask** How does the equation \( \frac{1}{3} \times \frac{1}{6} = s \) represent the ribbon in the problem? Explain the meaning of the number \( \frac{1}{3} \) and why the operation is multiplication.

**Listen for** The triangle has 3 equal sides, so each piece of ribbon will be \( \frac{1}{3} \) of Piper’s \( \frac{1}{6} \)-yard ribbon. To find \( \frac{1}{3} \) of \( \frac{1}{6} \), you multiply.
**CONNECT IT**

- Remind students that one thing that is alike about all the representations is the numbers.
- Explain that on this page students will use what they know about multiplying fractions to help them find quotients when they divide a unit fraction by a whole number.

**Monitor and Confirm**

1. and 3. Check for understanding that:
   - a ribbon that is \( \frac{1}{6} \) yard long is \( \frac{1}{6} \) of 1 whole yard
   - the \( \frac{1}{6} \)-yard length of ribbon needs to be divided into 3 equal pieces
   - \( \frac{1}{18} \) yard is the length of each piece of ribbon

**Support Whole Class Discussion**

2. In discussing problem 2, check that students understand how the division expression \( \frac{1}{6} \div 3 \) and the multiplication expression \( \frac{1}{3} \times \frac{1}{6} \) each describe one way to interpret the second diagram in Picture It. Then prepare them for problem 4, in which they will think about a different multiplication equation related to the quotient \( \frac{1}{6} \div 3 \).

Ask: Consider the whole number division problem \( 48 \div 12 = n \). How do you use the inverse relationship between multiplication and division to help you divide, or to check your answer?

Listen for: You can think about the related multiplication equation \( 12 \times n = 48 \) and find the missing factor, which is 4. To use multiplication to check that \( 48 \div 4 = 12 \), you find the product \( 12 \times 4 \), which is 48.

4. Look for the idea that the inverse relationship between multiplication and division shows that \( \frac{1}{6} \div 3 = \frac{1}{18} \) because \( \frac{1}{18} \times 3 = \frac{3}{18} = \frac{1}{6} \).

5. REFLECT

Have all students focus on the strategies used to solve this problem. If time allows, have students share their preferences with a partner.

**Hands-On Activity**

Act out the problem.

If . . . students are unsure about representing the division symbolically,

Then . . . use this activity to connect a concrete model to an abstract equation.

**Materials** For each student: yarn \( \frac{1}{2} \) foot, scissors, glue, ruler, sheet of paper

- Tell students they will use the \( \frac{1}{2} \) foot of yarn to make an equilateral triangle.
- Have students use whatever strategy they choose to make 3 equal-length pieces from the \( \frac{1}{2} \)-foot piece of yarn. Prompt students to write a division expression to describe what they have done so far, \( \frac{1}{2} \div 3 \).
- Tell students to glue the yarn pieces onto the paper to make an equilateral triangle, have them measure the length of each side as 2 inches, and guide them in writing this length as a fraction of a foot: 2 inches = \( \frac{1}{6} \) foot.
- Ask: What equation can you write to find the length of each piece when you divide a \( \frac{1}{2} \)-foot piece of yarn into 3 equal parts? \( \frac{1}{2} \div 3 = \frac{1}{6} \). Discuss how to use the related multiplication equation to check the answer: \( \frac{1}{6} \times 3 = \frac{3}{6} = \frac{1}{2} \).
APPLY IT

For all problems, encourage students to draw some kind of model to support their thinking. Allow some leeway in precision; drawing equal parts in fraction models can be difficult.

6 Each friend gets $\frac{1}{8}$ of the pizza; See possible work on the Student Worktext page. Students may also interpret the problem as finding $\frac{1}{2}$ of $\frac{1}{4}$ and use the multiplication equation $\frac{1}{2} \times \frac{1}{4} = \frac{1}{8}$.

7 $\frac{1}{12}$ of the whole garden has red roses; See possible model and division equation on the Student Worktext page.

Close: Exit Ticket

8 A; You can think of the problem situation as finding $\frac{1}{4}$ of $\frac{1}{3}$, which can be represented by the expression $\frac{1}{4} \times \frac{1}{3}$.

C; The related multiplication equation for the division equation $\frac{1}{3} \div 4 = \frac{1}{12}$ is $\frac{1}{12} \times 4 = \frac{1}{3}$.

Error Alert If students choose B, D, or E, then review using the inverse relationship between multiplication and division to write related multiplication and division equations, starting with whole numbers for both factors. Also have them analyze the models they drew and guide them to see how the models can be interpreted as representing $\frac{1}{3}$ of $\frac{1}{4}$ or $\frac{1}{4} \times \frac{1}{3}$.

Use what you just learned to solve these problems.

6 Felipe has $\frac{1}{4}$ of a pizza. He wants to share it equally with a friend. How much of the original whole pizza will each of them get? Show your work.

Possible student work:

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

Solution Each friend gets $\frac{1}{8}$ of the pizza.

7 Angela uses $\frac{1}{3}$ of her rectangular flower garden for roses. She plants equal rectangular areas of red, white, pink, and orange roses in this part of the garden. What fraction of the whole garden has red roses? Draw a model and write a division equation to represent and solve the problem. Possible student work:

<table>
<thead>
<tr>
<th>Red roses</th>
<th>White roses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Possible model and division equation on the Student Worktext page.

Solution $\frac{1}{12}$ of the whole garden has red roses.

8 Look at problem 7. Which multiplication expressions can be used to represent the situation or check the division equation?

- $\frac{1}{4} \times \frac{1}{3}$
- $4 \times \frac{1}{3}$
- $\frac{1}{12} \times 4$
- $\frac{1}{12} \times 3$
- $3 \times \frac{1}{4}$
LESSON 24
SESSION 2 Additional Practice

LESSON 24  Divide Unit Fractions in Word Problems

Name: ____________________________  LESSON 24  SESSION 2

Solutions

1. \( \frac{1}{8} \times \frac{1}{2} = \frac{1}{16} \)

2. Less than; Students may reason that a lesser amount of punch is poured into the same number of glasses, so the amount in each glass will be less. See possible description for how the model would change on the student page.

Medium

Practice Dividing a Unit Fraction by a Whole Number

Study the Example showing one way to solve a word problem involving dividing a fraction by a whole number. Then solve problems 1–5.

EXAMPLE

Felicia makes \( \frac{1}{2} \) gallon of fruit punch. She pours an equal amount into 8 glasses. What fraction of a gallon of fruit punch is in each glass?

Find \( \frac{1}{2} \div 8 \).

The model shows a rectangle divided into halves and then divided into 8 equal parts. There are a total of 16 parts, and one part is the amount of fruit punch in 1 glass.

\[ \frac{1}{2} \div 8 = \frac{1}{16} \]

The amount in 1 glass is \( \frac{1}{16} \) gallon.

1. What multiplication equation could you write to solve the Example?

   \[ \frac{1}{8} \times \frac{1}{2} = \frac{1}{16} \]

2. Suppose Felicia had made \( \frac{1}{4} \) gallon of punch and poured an equal amount into 8 glasses. Would the amount in each glass be more or less than \( \frac{1}{16} \) gallon? Explain how the model in the Example would change to show this.

   Less than; Possible explanation: The model would be divided into fourths instead of halves, so all the sections would be smaller.

Fluency & Skills Practice

Assign Dividing a Unit Fraction by a Whole Number

In this activity students divide unit fractions by whole numbers. This skill is useful in everyday situations involving fractional measurements. One such situation might involve distributing \( \frac{3}{4} \) gallon of juice equally among 5 children. Another would be dividing \( \frac{4}{5} \) cup of cooking oil into 4 equal amounts.

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Teacher Toolbox

Fluency and Skills Practice

Dividing a Unit Fraction by a Whole Number

Diane has \( \frac{1}{2} \) gallon of frozen yogurt and some bowls. She puts an equal amount of frozen yogurt into each bowl. For each given number of bowls, how much frozen yogurt will she put in each bowl?

a. 2 bowls       gallon
b. 3 bowls       gallon
c. 4 bowls       gallon
d. 5 bowls       gallon
e. 6 bowls       gallon

2. Eli uses \( \frac{1}{4} \) pound of apples to make 4 servings of fruit salad. He uses the same amount of apples for each serving. What amount of apples does he use for each serving of fruit salad?

   pound

3. Feng has a piece of wire that is \( \frac{1}{6} \) yard long. He cuts the wire into 2 pieces so that each piece is the same length. How long is each piece of wire?

   yard

4. Tia walked \( \frac{1}{2} \) mile in 5 minutes. She walked at the same rate for the entire distance. How far did Tia walk in 1 minute?

   mile

5. What is a pattern that you notice in problem 1?
Donal buys a $\frac{1}{32}$-pound package of cheese. There are 8 slices of cheese in the package. Each slice has the same weight. What fraction of a pound is each slice? Draw a model and write a division equation to represent and solve the problem.

Possible student work:

\[
\begin{array}{ccc}
\hline \\
\frac{1}{4} \times \frac{1}{8} = \frac{1}{32} \\
\frac{1}{2} \div 3 = \frac{1}{6}
\end{array}
\]

Solution $\frac{1}{32}$ pound

Student volunteers are getting ready to hand out programs at a talent show. Leah and Tomas are each given $\frac{1}{2}$ of a stack of programs to hand out. Leah divides her $\frac{1}{2}$ equally among herself and 2 friends. What fraction of the original stack of programs do Leah and her 2 friends each have? Show your work.

Students may use area models, equations, or some other method to find $\frac{1}{2} \div 3$.

Solution $\frac{1}{6}$ of the original stack

Look at problem 4. If Tomas divides his stack of programs between himself and his 3 friends, what fraction of the original stack will each of his friends have? Write a division equation to represent and solve the problem.

Possible work:

\[
\begin{array}{ccc}
\hline \\
\frac{1}{2} \div 4 = \frac{1}{4} \times \frac{1}{2} \\
\frac{1}{8} = \frac{1}{8}
\end{array}
\]

Solution $\frac{1}{8}$ of the original stack

Prepare for Session 3

Use with Apply It.

Levels 1–3

Speaking/Writing Read Apply It problem 11 aloud. Ask students to identify context clues for the word submarine (sandwich). Have them label the picture in the Student Worktext “submarine sandwich.” Then say: Dylan cut the sandwich into sixths. Ask: What fraction shows the size of each piece? $\frac{1}{6}$

Ask: How many pieces does Dylan get when he divides 3 sandwiches into pieces of size $\frac{1}{6}$?

Have students complete the sentence frame:

- Dylan gets _____ pieces.

Levels 2–4

Listening/Speaking Have students chorally read Apply It problem 11. Say: Dylan cut the sandwich into sixths. Ask: What fraction shows the size of each piece? $\frac{1}{6}$

Ask: How can you represent the action with numbers? Provide support as needed to help students state the division. Then ask: How many pieces does Dylan get when he divides 3 sandwiches into pieces of size $\frac{1}{6}$?

Have students complete the sentence frame:

- Dylan gets _____ pieces.

Levels 3–5

Listening/Speaking Have students read Apply It problem 11 with a partner.

Encourage them to discuss how they can represent the information they know and use that model to find the solution to the problem.

Have students use complete sentences to explain the model. Provide the following sentence starters:

- My partner and I know that _____.
- First, we show _____.
- Then we show _____.
- Dylan gets _____.
Lesson 24  Divide Unit Fractions in Word Problems

TRY IT
Read and try to solve the problem below.

Alex makes 2 pounds of bread dough. He splits the dough into \( \frac{1}{4} \)-pound loaves before baking them in the oven. How many loaves does he make?

**Sample A**
There are four \( \frac{1}{4} \)-pound loaves in each whole pound.
\[ 2 \times 4 = 8 \]
Alex made 8 loaves.

**Sample B**
2 pounds are divided into fourths.
\[ 2 \div \frac{1}{4} = 8 \]
Alex made 8 loaves.

**Math Toolkit**
- fraction tiles
- fraction bars
- fraction models
- number lines
- grid paper
- index cards

**DISCUSS IT**
Ask your partner:
Can you explain that again?

Tell your partner:
The strategy I used to find the answer was ...

**Develop Language**

Why Reinforce understanding of the word *split* in the context of fractions.

How Write the word *split* on the board. Explain that to split means to divide, separate, or break into parts. Have students circle the word in the Try It problem. Ask: What does Alex do when he splits the dough?

**TRY IT**

Make Sense of the Problem
To support students in making sense of the problem, have them identify the amount of dough Alex makes and the amount of dough each loaf needs.

Ask What size parts does Alex split the dough into?

**Common Misconception** Look for students who are not comfortable counting the number of equal parts and instead count the vertical lines dividing their model into equal parts, arriving at a solution of more than 8 loaves. As students present solutions, have them point out and count the loaves.

**Select and Sequence Student Solutions**
One possible order for whole class discussion:
- physical parts showing wholes and fourths
- drawings to represent the problem
- number lines marked to show wholes and fourths
- division or multiplication equations showing that Alex makes 8 loaves
Support Whole Class Discussion

Compare and connect the different representations and have students identify how they are related.

Ask  How does your model show the whole amount of dough? the equal parts each whole is divided into?

Listen for  Students should recognize that accurate representations show 2 wholes, each representing 1 pound of dough, divided into 4 equal parts, each representing one 1/4-pound loaf.

MODEL ITS
If no student presented these models, connect them to the student models by pointing out the ways they each represent:

• the 2 pounds of dough
• the equal parts each pound is divided into

Ask  In the second Model It, the number 2 is rewritten as the equivalent fraction 8/4. How does the number line in the first Model It show 2 is equal to 8/4?

Listen for  The number line is divided into 8 fourths between 0 and 2.

For a number line model, prompt students to identify the greatest number on the number line and the number of divisions.

• How is the number line divided?
• Why is it done that way?

For the equation model, prompt students to compare the two equations and tell how they are alike and how they are different.

• Why was 4 chosen as the common denominator?
• How is it helpful to think of 2 as 8/4?

Deepen Understanding

Equivalent Fractions

SMP 8  Use repeated reasoning.

When discussing the equation method shown in the second Model It, prompt students to consider where else they have used renaming as a strategy.

Ask  In your own words, how do you describe the strategy shown for dividing a whole number by a unit fraction?

Listen for  You rename the whole number, 2, as the fraction 8/4 so that the dividend and the divisor describe the same-size parts of a whole. You can then think of dividing 8 fourths into equal groups of 1 fourth.

Ask  Where else have you used a strategy of renaming? What are examples?

Listen for  Students should recognize that they have used a renaming strategy in many situations. Examples may include regrouping ones as tens, or tens as hundreds, to add whole numbers; writing decimals in tenths as decimals in hundredths to subtract decimals; and writing fractions with common denominators to add fractions.
**CONNECT IT**

- Remind students that one thing that is alike about all the representations is that they show dividing 2 wholes into same-size fractional parts.
- Explain that on this page students will use what they know about equivalent fractions and the relationship between division and multiplication to explain and check the quotient.

**Monitor and Confirm**

1. Check for understanding that:
   - 2 is the number of whole pounds of dough
   - 4 fourths are in one whole; 8 fourths are in two wholes

**Support Whole Class Discussion**

4. Tell students that these problems show how to use equivalent fractions to find the number of \( \frac{1}{4} \) in 2. In problem 7, they will think about how to use multiplication to check the answer.

Be sure students understand that the reason for writing 2 as a fraction with a denominator of 4 is so both the dividend and the divisor are expressed as a number of equal-size parts of 1 whole. The numerator shows the number of those parts in 2 wholes.

Ask How do the strategies discussed in problems 4 and 6 help you identify the quotient \( 2 \div \frac{1}{4} \)?

Listen for They help you think about how many \( \frac{1}{4} \) parts are in 2 wholes. They both show that 2 has 8 one-fourth parts.

7. Look for the idea that to check the quotient of a division equation you can use the inverse relationship between multiplication and division to write the related multiplication equation.

8. Reflect

Have all students focus on the strategies used to solve this problem. If time allows, have students share their preferences with a partner.

**Hands-On Activity**

Act out the problem.

If . . . students are unsure about using multiplication to check division, Then . . . use this activity to connect a concrete model to both equations.

**Materials** For each student: modeling clay (2 equal-sized portions)

- Tell students they will act out the problem of splitting up the bread dough. Explain that each portion of modeling clay represents 1 pound of dough.
- Guide students to divide each of the 2 pounds of bread dough into \( \frac{1}{4} \)-pound parts for the individual loaves. Discuss the division represented, \( 2 \div \frac{1}{4} \). Have students identify the quotient and write the division equation, \( 2 \div \frac{1}{4} = 8 \).
- Remind students division and multiplication are inverse operations—that multiplication undoes division. Have students put the \( \frac{1}{4} \)-pound portions back together to make whole pounds, reforming the original 2 portions. Discuss the multiplication represented, \( 8 \times \frac{1}{4} \). Have students write the multiplication equation that is related to the division equation above, \( 8 \times \frac{1}{4} = 2 \).
**APPLY IT**

For all problems, encourage students to draw a model to support their thinking. Allow some leeway in precision; dividing fraction models into equal parts can be difficult.

**9**

4 ÷ \( \frac{1}{2} \) = 8; 8 cards; See possible model on the Student Worktext page. Students may also draw 4 rectangles, each divided in half, with the halves numbered consecutively from 1 to 8. They may also write the division equation \( \frac{8}{2} ÷ \frac{1}{2} = 8 \), reasoning there are 8 groups of \( \frac{1}{2} \) in \( \frac{8}{2} \).

**10**

D; The multiplication expression \( 8 \times \frac{1}{2} \) can be used to check the equation \( 4 ÷ \frac{1}{2} = 8 \).

E; 2 cards can be made from each sheet of paper. There are 4 sheets, so \( 4 \times 2 \) represents the situation.

**Close: Exit Ticket**

**11**

Dylan stacks 18 sandwich pieces on the plate; Students may write the division equation \( 18 ÷ \frac{1}{6} = 18 \), reasoning there are 18 groups of \( \frac{1}{6} \) in \( \frac{18}{6} \). They may also draw a fraction model, such as 3 rectangles, each divided in sixths. Students’ solutions should indicate understanding of:

- 3 wholes divided into equal parts of size \( \frac{1}{6} \)
- There are 6 one sixths in each whole, so there are \( 3 \times 6 \), or 18 one sixths in 3 wholes.

**Error Alert** If students find a quotient other than 18, then have them write their division equation and then use multiplication to check their answer.

For example, if they find the quotient to be \( \frac{1}{2} \), have them write \( 3 ÷ \frac{1}{6} = \frac{1}{2} \) (the incorrect division equation) and then use \( \frac{1}{2} \times \frac{1}{6} \) to check. Point out that because \( \frac{1}{2} \times \frac{1}{6} = \frac{1}{12} \), not 3, the quotient for \( 3 ÷ \frac{1}{6} \) is not \( \frac{1}{2} \). Review that \( 3 ÷ \frac{1}{6} \) means to divide 3 wholes into parts, each of which is \( \frac{1}{6} \) of 1 whole.
### Lesson 24  Divide Unit Fractions in Word Problems

#### Lesson 24  Divide Unit Fractions in Word Problems

**LESSON 24**

**SESSION 3**

**Additional Practice**

**Practice Dividing a Whole Number by a Unit Fraction**

Study the Example showing one way to solve a word problem involving dividing a whole number by a fraction. Then solve problems 1–6.

**EXAMPLE**

Darius walks dogs at an animal shelter. He walks each dog for $\frac{1}{5}$ hour. He walks the dogs one at a time. How many dogs can Darius walk in 2 hours?

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

The number line shows two hours. Each hour is divided into fifths.

There are 10 fifths in 2.

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

Darius can walk 10 dogs in 2 hours.

1. What multiplication equation could you write to solve the Example?
   $2 \times 5 = 10$

2. Use the information from the Example. In one month, Darius spends 9 hours walking dogs. How many times does he walk a dog in one month?
   45 times

3. Explain how you got your answer to problem 2.
   Answers will vary. Possible explanation: I know Darius can do 5 dog walks in 1 hour, so in 9 hours he can do $\frac{9}{5}$, or 45, dog walks.

---

**Fluency & Skills Practice**

Assign **Dividing a Whole Number by a Unit Fraction**

In this activity students divide whole numbers by unit fractions. This skill can be used in everyday activities such as cooking. For example, suppose a person is making cheese-stuffed potatoes. Each potato requires $\frac{1}{4}$ cup of milk, and the cook has 2 cups of milk. By dividing 2 by $\frac{1}{4}$, the cook finds that he or she has enough milk to make 8 cheese-stuffed potatoes.

**Teacher Toolbox**

**Fluency and Skills Practice**

**Dividing a Whole Number by a Unit Fraction**

1. Each whole is divided into 5 fifths, so 2 wholes show $2 \times 5$, or 10 fifths.  
   Basic

2. 45 times; Students may write and solve the division equation $9 \div \frac{1}{5} = n$ or the multiplication expression $9 \times 5 = n$. They may also extend the number line in the example to show the number of $\frac{1}{5}$s in 9.  
   Medium

3. See possible explanation on the student page. Students may also explain how they counted the number of $\frac{1}{5}$s in a model they drew that showed 9 wholes.  
   Medium
4. Mrs. Wing will tape up posters made by her students on the wall. She cuts tape into $\frac{3}{4}$-foot pieces. How many $\frac{3}{4}$-foot pieces can she cut from 5 feet of tape? Show your work.

Students may use area models, equations, or some other method to find $5 \div \frac{1}{4}$.

**Solution**

$20$ pieces

5. Taylor is helping decorate tables with flowers for a graduation celebration. She has 7 bunches of tulips. She will put $\frac{1}{2}$ of each bunch in a vase. How many vases does she need? Draw a model and write a division equation to represent and solve the problem.

![Tulips](image)

$\frac{7}{2} = 14$ vases

**Solution**

$14$ vases

6. Look at how you solved problem 5. Use a different way to solve the problem and show how a multiplication equation can be used to check the answer.

Students may use area models, equations, or some other method to find $\frac{7}{4} \div \frac{1}{2}$. It should be different than the way shown in problem 5. Students may use the equation $\frac{14}{2} = 7$ to check their answer.

**Solution**

$14$ vases

---

**Prepare for Session 4** Use with **Apply It**.

**Levels 1–3**

**Speaking/Listening** Have students chorally read **Apply It** problem 3. Ask them to state what is known and unknown about the problem:

- *I know:* Devonte uses _____ for each event.
- Devonte fills _____ of one sheet of paper.
- *I need to know:* how many _____ Devonte makes notes for.

Have partners make a model and write a division expression.
When complete, ask: *Did Barry get the correct answer?* Why?

**Levels 2–4**

**Speaking/Listening** Have students chorally read **Apply It** problem 3. Ask them to state what is known and unknown about the problem:

- *I know:* Devonte uses _____ and _____.
- *I need to know:* _____.

Have partners make a model and write a division expression.
When complete, ask: *Did Barry get the correct answer?* Why?

---

**Levels 3–5**

**Reading/Writing** Have students chorally read **Apply It** problem 3. In partners, have students discuss what is known and unknown about the problem. Ask partners to make a model to show the number of events Devonte makes notes for.

Have students use sequence terms (*first, then, last*) to write the steps they took to write a division expression.

Then have them compare their answer with another group. When complete, have students work together to explain how Barry got D as an answer.
SESSION 4  
Refine  
Dividing Unit Fractions in Word Problems

**Purpose**  
In this session students solve word problems involving dividing a whole number by a unit fraction or a unit fraction by a whole number. They then discuss and confirm their answers with a partner.  

**Before students begin to work**, use their responses to the **Check for Understanding** to determine those who will benefit from additional support.  

**As students complete the Example and problems 1–3**, observe and monitor their reasoning to identify groupings for differentiated instruction.

---

### Start

#### Check for Understanding

**Why**  
Confirm understanding of solving a word problem that involves dividing a unit fraction by a whole number.

**How**  
Have students draw a visual model and write a division equation to solve the problem.

**Solution**  
Draw a visual model and write a division equation to solve.  

A pitcher contains \( \frac{3}{5} \) gallon of juice. If 5 friends share the juice equally, how much does each person get?

---

#### APPLY IT

1. Corrine picked \( \frac{3}{5} \) gallon of blackberries. She poured equal amounts of berries into 4 containers. What fraction of a gallon is in each container? Show your work.

**Possible student work using a model:**

![Visual model](image)

**Solution**  
\( \frac{1}{10} \) gallon

---

**Error Alert**

<table>
<thead>
<tr>
<th>If the error is . . .</th>
<th>Students may . . .</th>
<th>To support understanding . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>have thought that the answer is the number of parts in the whole after dividing.</td>
<td>Have students draw an area model or a number line and identify ( \frac{1}{5} ). Then, have students divide the fifth into 5 equal-sized pieces. Point out that each friend gets one of these pieces, which is ( \frac{1}{5} ) of ( \frac{1}{5} ), or ( \frac{1}{5} \times \frac{1}{5} ).</td>
</tr>
<tr>
<td>1</td>
<td>have multiplied instead of dividing.</td>
<td>Write ( \frac{1}{5} \times 5 ) and ( \frac{1}{5} \div 5 ) and discuss what each expression means in the context of the problem. ( \frac{1}{5} \times 5 ) could mean “( \frac{1}{5} ) of 5 friends” or “each of 5 friends has ( \frac{1}{5} ) gallon.” These do not describe the problem situation. ( \frac{1}{5} \div 5 ) means “( \frac{1}{5} ) gallon divided (or shared) among 5 friends,” which describes the problem situation exactly.</td>
</tr>
</tbody>
</table>
**EXAMPLE**

18 photos; the fraction model shown is one way to solve the problem. Students could also solve the problem using the expression $3 ÷ \frac{1}{6}$ or $6 \times 3$. They may also use a different kind of fraction model, such as a number line.

**Look for** You find the number of $\frac{1}{6}$s in 3.

**APPLY IT**

1. $\frac{1}{16}$ gallon; Students could solve the problem by drawing a model divided to show fourths one way and divided into 4 equal parts the other way, with the overlapping shading showing $\frac{1}{16}$.
   
   **Look for** Find one of 4 equal parts of $\frac{1}{4}$ gallon.

2. $\frac{1}{10}$ of the drive; Students could solve the problem by representing it with the equation $\frac{1}{2} ÷ 5 = f$, using reasoning to think of it as finding $\frac{1}{5}$ of $\frac{1}{2}$, or $\frac{1}{5} \times \frac{1}{2} = f$.
   
   **Look for** Find one of 5 equal parts of $\frac{1}{2}$.

3. B; Students could solve the problem by reasoning that the starting amount, 2 sides, is divided into groups that are $\frac{1}{8}$ page in size.

**Example**

Cooper’s USB drive is $\frac{1}{2}$ full with 5 video files. Each video file is the same size. What fraction of the USB drive does 1 video file use?

**Show your work.**

**Possible student work using an equation:**

$\frac{1}{2} ÷ 5 = f$

$f = \frac{1}{2}$ of $\frac{1}{2}$

$\frac{1}{5} ÷ \frac{1}{2} = f$

$\frac{1}{5} ÷ \frac{1}{2} = \frac{1}{10}$

**Solution** $\frac{1}{10}$ of the drive

**3** Devonte is studying for a history test. He uses $\frac{1}{8}$ of a side of one sheet of paper to write notes for each historical event. He fills 2 full sides of one sheet of paper. Which expression could be used to find how many events Devonte makes notes for?

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

B $\frac{1}{8}$

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

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

Barry chose D as the correct answer. How did he get that answer?

**Possible answer:** Barry knew that he should write a division expression with 2 and $\frac{1}{8}$, but he thought that the order of the numbers didn’t matter in division.

**PAIR/SHARE**

How can you check your answer?

How could I represent this problem using an equation?

Is this problem like one you have seen before?

**Does Barry’s answer make sense?**

**Possible student work using an equation:**

$\frac{1}{8}$ is $\frac{1}{5}$ of $\frac{1}{2}$.

$\frac{1}{8}$ is $\frac{1}{3}$ of $\frac{1}{2}$.

$$
\frac{1}{8} ÷ \frac{1}{2} = \frac{1}{10}
$$

**Solution** $\frac{1}{10}$ of the drive
Apply It

4. Each pound has two halves, so each pound can make 2 containers of applesauce. Elise has 6 pounds. $6 \times 2 = 12$. 

   **DOK 2**

5. Divide each mile shown on the number line in thirds, to show the distance each team member will run. Count the number of $\frac{1}{3}$.

   **DOK 2**

6. Each piece is $\frac{1}{18}$ of the cake; Represent cutting the $\frac{1}{3}$ cake into 6 equal pieces with the expression $\frac{1}{3} \div 6$. Think of that as finding $\frac{1}{6}$ of $\frac{1}{3}$ and write it as the expression $\frac{1}{6} \times \frac{1}{3}$.

   **DOK 2**

Error Alert Students may write the whole number 6 instead of the fraction $\frac{1}{6}$ when writing the related expression for $\frac{1}{3} \div 6$; writing instead $6 \times \frac{1}{3}$ and showing the answer $\frac{6}{3}$.

---

Differentiated Instruction

**RETEACH**

**Hands-On Activity**

Use fraction circles to divide a whole number by a unit fraction.

**Students** struggling with understanding dividing by a unit fraction

**Will benefit from** additional work with concrete representations

**Materials** For each student: 1 set of fraction circles or tiles
- Distribute materials. Pose the following problem: A painter can paint $\frac{1}{3}$ of a room in an hour. How many painters are needed to paint 6 rooms in an hour?
- Have students trace the whole fraction circle six times to represent 6 rooms. Ask: How much of a room can 1 painter paint in 1 hour? $\frac{1}{3}$ of a room | Ask: How many painters are needed to paint an entire room in 1 hour? [3 painters] Have students place one-third fraction pieces in one circle to show this.
- Have students divide the remaining whole circles into thirds to show the painters needed for each room. Ask students to write a division equation for the problem and a solution. $6 \div \frac{1}{3} = 18$; 18 painters | Repeat the activity for other numbers of rooms, such as 3 or 5.

**EXTEND**

**Challenge Activity**

Write and solve equations.

**Students** who have achieved proficiency

**Will benefit from** deepening understanding of division with unit fractions

- Challenge students to write a division equation showing a whole number divided by a unit fraction that has a quotient of 12. [Possible answer: $3 \div \frac{1}{4} = 12$]
- Challenge students to solve a division equation involving a mixed number. Ask them to solve $4 \frac{1}{2} \div \frac{3}{2} = n$. [Possible answer: $\frac{3}{2}$]
Marina has a pattern to make bows that requires \( \frac{1}{4} \) yard of ribbon for each bow. Fill in the table to show how many bows she can make from a given length of ribbon.

<table>
<thead>
<tr>
<th>Ribbon Length (yards)</th>
<th>Number of Bows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
</tbody>
</table>

Part A
Ted serves \( \frac{1}{6} \) gallon of ice cream. He puts an equal amount of ice cream in each of 4 bowls. How many gallons of ice cream does Ted put in each bowl?

Solution
Ted puts \( \frac{1}{24} \) gallon of ice cream in each bowl.

Part B
\( \frac{1}{6} \div 4 = \frac{1}{24} \times \frac{1}{4} = \frac{4}{24} \), or \( \frac{1}{6} \).

Solution
Ted puts \( \frac{1}{24} \) gallon of ice cream in each bowl.

Part B
Write a division equation to represent this situation. Then write a multiplication equation you can use to check your answer.

Possible student model:

Possible problem:
Willa uses \( \frac{1}{5} \) lb of clay to make 4 equal-sized beads for a necklace. How heavy is each bead?

Possible student work:
Each bead is \( \frac{1}{20} \) lb.
LESSON 24
Lesson Quiz

Tested Skills

Assesses 5.NF.B.7c

Problems on this assessment form require students to be able to use visual models and equations to represent and solve real-world problems involving division with unit fractions. Students will also need to be familiar with multiplying unit fractions by whole numbers, multiplying unit fractions, and multiplying and dividing with whole numbers.

Alternately, teachers may assign the Digital Comprehension Check online to assess student understanding of this material.

Error Alert Students may:

• multiply instead of divide.
• not check that the answer is reasonable in the context of the problem.
• confuse the dividend and the divisor.
• replace a unit fraction \( \frac{1}{a} \) with its related whole number \( a \) or vice versa.

Solutions

1 D; The student could solve the problem by recognizing that \( \frac{1}{3} \) is divided into 2 equal parts and each part represents \( \frac{1}{6} \) of the whole.

A is not correct because \( \frac{1}{3} \) was multiplied by 2.

B is not correct because \( \frac{2}{6} \) represents the total of the two pieces.

C is not correct because \( \frac{1}{2} \) represents a yard divided into two equal parts.

1 point

5.NF.B.7c, DOK 2

2 Rita is painting the walls in the playrooms at the daycare center. She estimates that she will need \( \frac{1}{4} \) gallon of paint for each wall. How many walls can she paint with 5 gallons of paint? Show your work. (2 points)

Possible student work:

\[ 5 \div \frac{1}{4} = 5 \times 4 = 20 \]

Solution 20 walls

3 Wen and five friends equally share \( \frac{1}{3} \) of a pan of snack bars. Which expressions show how much of the pan each person gets? Decide if each expression is correct.

Choose Yes or No for each expression. (2 points)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>E</td>
<td>F</td>
</tr>
</tbody>
</table>

1 point

5.NF.B.7c, DOK 2
Yolanda has a \( \frac{1}{6} \)-cup ladle that she uses to pour gravy over potatoes. She uses one full ladle for each serving of potatoes.

**Part A**

Yolanda makes this table to show how many servings of potatoes she can make for the given amounts of gravy. Complete Yolanda’s table. Write your answers in the blanks. (2 points)

<table>
<thead>
<tr>
<th>Cups of Gravy</th>
<th>Number of Servings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
</tr>
</tbody>
</table>

**Part B**

Yolanda has 6 cups of gravy. How many servings of potatoes can she make? Show your work. (2 points)

Possible student work:

\[
6 \div \frac{1}{6} = 6 \times 6 = 36
\]

36 servings

---

**Differentiated Instruction**

**RETEACH**

**Tools for Instruction**

**Students** who require additional support for prerequisite or on-level skills

**Will benefit from** activities that provide targeted skills instruction

**REINFORCE**

**Math Center Activities**

**Students** who require additional practice to reinforce concepts and skills and deepen understanding

**Will benefit from** small group collaborative games and activities (available in three versions—on-level, below-level, and above-level)

**EXTEND**

**Enrichment Activities**

**Students** who have achieved proficiency with concepts and skills and are ready for additional challenges

**Will benefit from** group collaborative games and activities that extend understanding